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FROM THIS ROOM**MAGAZINE**VOLUME 5 NUMBER 17
OCTOBER 14, 1986

The Cheapest PCs Ever!

PC Labs Tests 18 Low-Cost Compatibles

- Three \$100 Lotus 1-2-3 Knockoffs
- The Language of AI: 7 PROLOGs Compared



**386 EXCLUSIVE!
FIRST LOOK AT
COMPAQ'S 32-BIT PC**

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How Borland is helping bring the America's Cup back to America!

"I think those who grasp the technology will prevail"

Bill Shore, President,
Shore Sails Co., Newport, RI



Borland's Philippe Kain of the team of America's Cup Challenger "Heart of America," with Shore Sails' President Bill Shore

"Sail-making is traditional—a craft—but I think we're huge steps ahead of the competition when we get involved with higher technology," says Shore.

He and Shore Sails' 17 different franchised sail loft in the U.S. are in what Shore describes as a "highly competitive business, whether it's America's Cup racing or any race." And he adds, "You guys (Borland) do good stuff that's affordable, which is one of the reasons why we wrote all our sail design programs in Turbo Pascal."

"These days," he says, "there are many parts to a sail, and Turbo Pascal lets us arrange all the parts properly. We design what the garment industry calls a 'marker'—and rely on Turbo Pascal to do critical things like getting thread lines in the same direction as load lines.

We take the diskette to our new \$250,000 laser cutter, which follows the Pascal program precisely, draws out the sail and cuts out the sail. We glue and sew and you've got the best there is."



"Heart of America" surfing downwind, Santa Cruz, California

"The wrong sails will sink your chances—if not your boat—so we wrote Turbo Pascal programs"

Win Fowler, Shore Sails Co.,
Portland, Maine

The right sail design, at the right price, right now, has to happen in 17 different Shore Sails Lofts across America.

It had to happen with America's Cup challenger Heart of America which carries Shore sails—and it has to happen with the (currently) 700 different boats that Shore Sails has in their Turbo Database Toolbox."

Sail design, sail pricing and "beating the handicapper" are all done at Shore Sails with Turbo Pascal.

In case you don't know the sharp end from the blunt end of a boat, the right sail design for any boat is more than design and price. It's tactical advantage. Designing sails that take the greatest advantage of the boat's basic design and rigging without getting stuck with a heavier-than-desirable Official Handicap. (Handicaps can eat your chances faster than a Great White.)

The "right sail" design bends but doesn't break the

racing rules written by, amongst others, MORR (Midwest Offshore Racing Rules) or IOR (International Offshore Rules). Turbo Pascal spills out "right sail" designs for Shore Sails so their customers tend to "handicap" the Rules Committee instead of the other way around.

Shore Sails' connection with Borland doesn't end with Turbo Pascal and our Database Toolbox.

Shore's Fowler has also written SuperKey* macros for "every file we have" and says, "We'd be lost without them."

He uses SideKick* to dial every phone call and SideKick's Notepad to communicate between all the Lofts, saying, "That way we don't need a word processor." Shore Sails also uses Turbo Lightning* and Reflex: The Analyst.*

So why so many Borland products in one company?

Win Fowler says, "We'd be sunk without them!"

CIRCLE 138 ON READER SERVICE CARD

"There is no second prize" Omar Bradley

Sail designs generated from Shore Sails' Turbo Pascal programs



Scratch this card now and you could *instantly*
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for the America's Cup Race!

\$10,000



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\$8,895



\$4,499



\$69.95



See Official Rules on the back of this card for details.

Don't delay! There will be a second-chance drawing for the trip if not claimed by 12/30/86. There's also a second-chance drawing for the two Suzukis if not claimed by 2/28/87. All rebate coupons are good for products purchased 9/5/86-3/31/87. Product prices above are suggested list prices.

*Rub the silver box to reveal whether
you win a prize or get a rebate coupon.
Then fill in the second-chance entry
blank to the right.*

**SCRATCH
'N WIN!**

**Second-Chance
Sweepstakes
Entry!**

We're running two Second-Chance Sweepstakes drawings to award the trip and cars. They will be won by someone—it could be you! Fill in the entry coupon and mail it now. Winners will be notified immediately, because the final America's Cup races start in Australia on January 31, 1987, and you'll have to pack in a hurry.

(You will need a valid passport and the ability to comprehend Australian versions of the English language.)

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OFFICIAL RULES - BORLAND INSTANT WINNER GAME

1. NO PURCHASE NECESSARY. To participate, you may obtain a game card mailed into the October, November, December, or January issue of the following magazines: PC World, Byte, PC Tech Journal, PC Magazine. You may also obtain a game card by making a self-addressed, stamped envelope to: Borland International Game Card, P.O. Box 9370, Woburn, CT 06897 (Washington State residents and self-addressed envelope). Limit one game card per stamped request. All requests must be received by January 15, 1987.

2. TO PLAY. Reveal the sub-off area on the game card to reveal what prize or rebate offer you have obtained.

3. PRIZE/REBATE. Reveal the sub-off area of the following prizes may be awarded: Trip for Two to America's Cup Races or \$10,000; 1986 Suzuki 4W Samurai Convertible or \$8,895; AST Turbo Laser; Toshiba 11000 Portable Computer; Toshiba 3100 Portable Computer; AST 500 Performance; AST 486 Performance; AST 510 Plus; AST Rampage AT; Free Borland Product, or you may obtain the following rebate offer: \$10 rebate offer on any individual product or \$15 rebate offer on any single advertised Borland bundle (See rule #11 for prize details).

4. PRIZE CLAIMS. If you obtain one of the prizes stated in Rule #3, sign your full legal signature on the game card and send via certified mail (copy should be made for your records), along with your name and address to: Borland International Prize Claim, 1980 Quaker Road, Woburn, CT 06897. All prize claims must be received or postmarked by February 15, 1987 (See Rule #12 for Trip for Two to America's Cup exception).

5. REBATE CLAIMS. Rebates are good for products purchased from September 5, 1986 through March 31, 1987. The \$10 rebate is good for any individual Borland product and the \$15 rebate is good for any advertised Borland software bundle. To receive your rebate you must return your completed rebate agreement from the manual, disc game card and dated proof of purchase to: Borland International, Game Card Rebate, 4385 Scotts Valley Drive, Scotts Valley, CA 95086. Upon receipt of the rebate agreement, game card and proof of purchase, Borland will send your check. Rebate is not valid with any other rebate or promotion offered directly from Borland.

6. VERIFICATION. All game materials are subject to verification. Game materials are void and will be rejected if not obtained through authorized, legitimate channels, and may be rejected if any part is reproduced, counterfeited, torn or altered in any way or if materials contain printing, typographical, or mechanical errors. Decisions of the Verification Center are final. Game prizes from any game other than the Borland Instant Winner Game may not be used in this game.

7. CONDITIONS OF PARTICIPATION. Material submitted becomes the property of Borland International. The submission of game pieces is the sole responsibility of the individual seeking verification, who is solely responsible for lost, late, or misdirected mail. All rules, registration and inspection fees are the sole responsibility of the verified winner. Winners may be required to execute an affidavit of eligibility and name and likeness publicity release. By participating in the game you accept and agree to be bound by these rules and the decision of the Official Redemption Center which will be final.

8. ELIGIBILITY. Participation is open solely to residents of the United States 18 years of age and over, except employees and agents of Borland International, service agencies, and individuals engaged in the development, production, or distribution of game materials. The Merrill Group, Inc. and their immediate family or assembly of their households. Void in Vermont and where prohibited by law.

9. GAME SCHEDULE AND AWARD OF PRIZES. The Borland Instant Winner Game will commence on or after September 5, 1986 and end on January 30, 1987. If well officially end, however, when all game pieces are distributed. Voided game pieces will be awarded within thirty (30) days from the date of their receipt for verification at the Official Redemption Center. A major prize winner, not can be obtained by sending a stamped, self-addressed envelope to: Borland Instant Winner Game, Woburn, MA, P.O. Box 9389, Woburn, CT 06897.

10. ODDS CHART. The odds of winning prizes are based upon obtaining the one true game piece among the applicable number of game pieces.

PRIZE	Qty	Total Value	Odds of Winning
Trip for Two to America's Cup or \$10,000	1	\$ 10,000.00	1 in 6,458,000
Suzuki 4W Samurai Convertible JA or \$8,895	2	\$ 17,790.00	1 in 3,229,000
AST Turbo Laser	1	\$ 4,995.00	1 in 645,800
Toshiba Portatile Computer	2	\$ 8,898.00	1 in 3,229,000
AST Memory Boards	25	\$ 15,025.00	1 in 258,320
Borland Products	1,000	\$149,000.00	1 in 6,458
BORLAND TOTAL	1,631	\$196,788.00	1 in 6,244

All non-winning game cards will contain a \$10 rebate good on any individual Borland product or a \$15 rebate good toward any advertised Borland software bundle.

11. PRIZE DETAILS. Trip for Two to America's Cup Races (or \$10,000) will include coach seating round trip airfare on regularly scheduled commercial airline from San Francisco, California to Perth, Australia and up to two weeks hotel accommodations in Perth. Airfare plus \$4,500 spending cash. Winners will be responsible for obtaining visa, passport, and all other travel documents. Trip does not include meals, taxes, excess baggage charges and other hotel charges. Meals must be accompanied by parent or legal guardian. Suzuki 4W Samurai Convertible JA (or \$8,895) - verified winner will be responsible for all registration, insurance, and licensing fees. AST Turbo Laser; Toshiba Portatile Computer Model # T1100; AST Memory Boards and Free Borland Products are non-substitutable except by sponsor due to product availability and allowances and guarantees are subject to manufacturers terms. All prizes are non-transferable. Winning consumer is responsible for all local, state and federal taxes.

12. SECOND CHANCE SWEEPSTAKES. There are two Second Chance Sweepstakes drawings scheduled to be conducted on December 31, 1986 and February 28, 1987. Random drawing from all entries received by December 30, 1986 will award trip for two to America's Cup Races (or \$10,000). Random drawing from all entries received by February 28, 1987 will award two (2) Suzuki 4W Samurai (or \$8,895). All remaining prizes that are unclaimed after February 15, 1987 will remain unclaimed.

If you have any questions concerning the Borland Instant Winner Game, call 1-800-451-6471.

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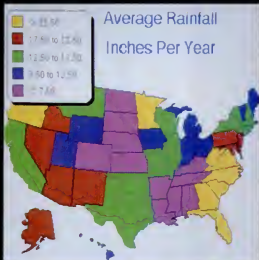
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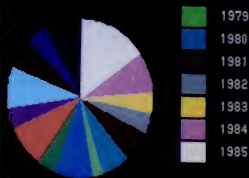
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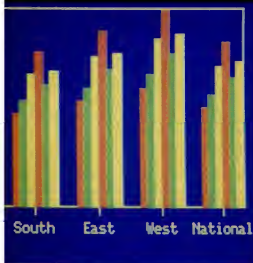
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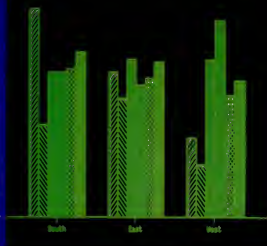
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FEATURES

SPECIAL REPORT Optical Overview: What's Coming in CD-ROMs and WORMs

John Helliwell/Compact disc technology is asserting itself in the PC market. Along with CD-ROMs, write-once, read-mostly (WORM) laser drives offer exciting database applications, and in this comprehensive overview you'll learn how these systems function. 149

SOFTWARE 1-2-3 Knockoffs: How Close Do They Come?

Jared Taylor/Can any spreadsheet software package challenge 1-2-3 and come away looking good? Here are three inexpensive spreadsheet programs that aim to give 1-2-3 a run for its money 167

Easier than DOS DEBUG: Six Utilities for Byte-Level Editing

Winn L. Rosch/These six programs can help you recover erased files, change any byte on any disk, or even disassemble programs to see how they work—all without the complications of DOS's DEBUG program 217

HARDWARE New Plotters: All the Way from A to E, Part I

Glenn Hart/As high-quality graphics become a part of many work environments, interest in plotters continues unabated. Since our review of 24 plotters last December, many new models have been introduced, and in this, the first of a two-part survey, five desktop plotters are put to the test. 179

Musical Interludes with the PC

Winn L. Rosch/If you merge your PC with Roland's Musicom or the Tecmar Music Synthesis System, you and your computer can make beautiful music together. 265

TRAINING Management Training: Business Simulation on the PC

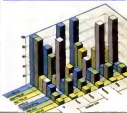
Vincent Puglia/How effectively can the skills of management be taught by interaction with a



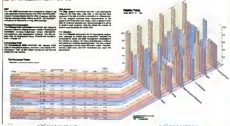
simulated business world on the screen of a PC? These three programs give you a chance to run the business to learn how to be a manager 229

LANGUAGES PROLOG: A Language for Artificial Intelligence

William G. Wong/PROLOG has emerged as a premier language by virtue of its ability to do things that are difficult to do with other languages. Have a look at seven PROLOG systems. 247



IBM PC-compatible
Hardware Prices
Listed in Dollars (to April 14, 1988)



COVER STORY

The Cheapest PCs Ever

Paul M. Stafford/Prices on IBM PC- and XT-compatible microcomputers continue to drop, and the bottom is nowhere in sight. Only a year ago it would have been impossible to gather together a significant number of PCs with base prices at or below \$1,000, but the collection of 18 inexpensive PCs featured here demonstrates how large the market has become in a very short time. 122



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Cover Photograph:
Roberto Brosan

WHAT'S INSIDE



Paul M. Stafford

You can't miss them. The media is awash in ads for cheap PCs. Turn the pages of your daily newspaper or check a recent issue of *PC Magazine*. Cheap PCs are popping up all over the place. And the lowest price keeps getting lower every day. With advertised prices as low as \$500 to \$600 for system units, you can't help but wonder: Are they any good? Are you trading off performance and reliability for low price?

To find out, the *PC Magazine* staff sought out every PC- and XT-compatible system that listed a base price of under \$1,000. Eighteen met the criterion.

But when the 18 got into *PC Magazine* Labs to undergo more than 200 hours of testing for speed, compatibility, and reliability, our reviewers found the bargains were not without compromises. One was the level of workmanship on some—but not all—machines. For instance, one tester had to physically stretch the base of a cheap PC to wedge a standard-length EGA board into an expansion slot. Another was price. The price that catches the eye in an advertisement is often for a bare-bones system unit. By the time you add a monitor, monitor card, and I/O ports, as well as a second drive and more memory, the price you pay nearly doubles.

Staff editor Paul M. Stafford, who wrote "The Cheapest PCs Ever," which begins on page 122, says of the bargain contenders: "We have high standards. Any machine that claims to be PC compatible had better be tough, too."

Just as IBM defined the hardware standard and then found itself surrounded by clones, the success of Lotus's 1-2-3 spawned a mass of imitators. Contributing editor Jared Taylor looks at three \$100 1-2-3 knockoffs—*VP-Planner*, *Farsight*, and *The Twin*—in "1-2-3 Knockoffs: How Close Do They Come?" (see page 167) and lets you know just how much of 1-2-3 you get for your money.

However cheap a program may be, free is always cheaper. This issue's programming column brings you the memory-resident POP-CAL, which displays a monthly calendar on-screen without biting off a big chunk of memory. And for more tricks, check out our first installment of Turbo Power User. Edited by professional Pascal programmer Neil J. Rubenking, it will alternate with the Power User column edited by technical editor Craig Stark.

PC Magazine's editors got their hands on the Intel 80386-based Compaq Deskpro 386 and report their findings in First Looks beginning on page 33. *PFS:First Choice*, a \$149 integrated package, could be as big a hit as *PFS:Write*. In First Looks, frequent contributor Alfred Poor reviews this word processor-spreadsheet-database-communications program.

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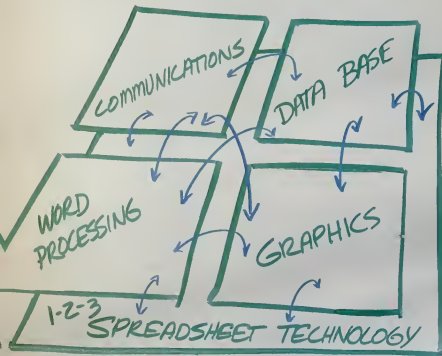
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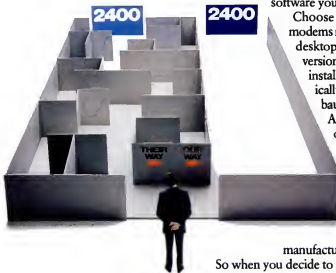
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LETTERS TO PC MAGAZINE



DOS TO TRAVEL

"DOS to Travel" (*PC Magazine*, Volume 5 Number 13) was one of the most comprehensive and informative pieces yet written on portable computers in the marketplace today. I believe the end user or dealer trying to come to grips with products currently available is well served by your article.

Let me clarify several facts about the Datavue computer. First, the 16.2 pounds given as the weight of the Datavue is for our 20-megabyte internal hard drive model. The floppy disk drive models (either the 5¼-inch or dual 3½-inch) weigh between 12.5 and 14 pounds. Also, the optional battery pack available for the floppy drive models can be recharged while using the Datavue.

Bonnie L. Herron
Quadrant Corp.
Norcross, Georgia

Your recent review "DOS to Travel" contained some factual errors, particularly about the Kaypro 2000. For instance, John Dickinson said the only way to switch the 2000 on and off is to open and close the case. All you have to do is press Ctrl-Alt-S to bring up the KSTATUS utility and toggle the power option.

Mr. Dickinson also claimed the machine's LCD screen has no contrast adjustment and its viewing angle cannot be changed. Contrast is controlled using Ctrl-Alt-F2 and Ctrl-Alt-F1, while the screen angle adjusts by sliding the release switch at its lower-right-hand edge.

Willie Wisely
Santa Ana, California

John Dickinson replies:
My apologies for missing the on/off utility

and contrast control in the documentation, but finding them wouldn't have changed my mind—what, after all, is wrong with a simple on/off switch and a contrast control that works using an ordinary knob? In addition, try as I might, the slide switch on the model I tested would not release the screen, so the angle couldn't be changed.

Your review of DOS-compatible portables ("DOS to Travel") reflected the completeness and accuracy I have come to expect from your publication. However, the



Sharp PC-7000 is not IBM hardware compatible as mentioned, because of its non-IBM memory architecture. The range of IBM cards that can be added with the optional expansion unit is thus quite limited, contrary to your reviewer's implication.

Charles Feinstein
Honolulu, Hawaii

You are correct—the Sharp PC-7000 is not IBM hardware compatible. However, while the article briefly mentioned the existence of an expansion unit, we did not evaluate it, so there should have been no implication that the PC-7000 could definitely handle IBM cards.—Ed.

I recently purchased a Panasonic Exec. Partner but found that the specs for my

Exec. Partner differ from the ones that you listed in your review of portable computers ("DOS to Travel"). According to documentation that came with my computer, the Exec. Partner uses an 8086-2 CPU, not an 8088-2 as stated in your article. Also, the visible part of the display measures just over 9 inches diagonally. You must have measured the whole plasma display panel to get an 11-inch display.

Elizabeth A. Swoope
Baton Rouge, Louisiana

Yes, the Exec. Partner does require an 8086-2.—Ed.

DEBATING DESKTOP PUBLISHING

Bill Machrone's recent editorial in *From the Editor's Screen* (*PC Magazine*, Volume 5 Number 13) brought to the fore a number of my pet peeves. Although a certain amount of pro-IBM grandstanding is to be expected, it seems this is clouding your collective editorial eyes.

Apple, with the Macintosh and LaserWriter, has defined something called desktop publishing. It involves the use of multiple applications programs that lead to a page composition program, which is used to integrate the components. This requires standard data formats, a standard user interface across various applications programs, virtual device interfaces, a WYSIWYG screen, and high-quality output of integrated text and graphics. Since only the Macintosh/LaserWriter combination embodies all these requirements, it is no wonder that you are demystifying desktop publishing. When *Microsoft Windows* takes over, there will be an environment that allows complete desktop publishing capability on IBM PCs and compatibles, but for now, it might be time to do another

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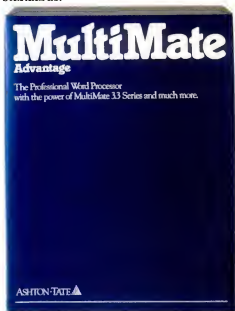
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VIEWPOINTS

■ LETTERS

article comparing the Macintosh with an equally equipped IBM system.

David Anderson
Freehold, New Jersey

You're absolutely right—the PC market's collective tongue is hanging out for Macintosh-like graphics capabilities. The good news is that it's coming, and with all the benefits of the PC's open architecture. As for comparing the Mac Plus with the PC AT, we'd rather wait until the open-architecture Mac is available.—Ed.

My anxieties about desktop publishing have finally been given the attention they deserve (From the Editor's Screen, *PC Magazine*, Volume 5 Number 13). Bill Machrone couldn't have said it any better than he did, and I thank him for taking a re-

■ Owning a desktop publishing system will not make me a designer any more than owning a Steinway will make me a pianist.

alistic look at the aesthetic side of desktop publishing.

Desktop publishing boosts typeset quality and creates professional-looking documents, but there is a difference between typography and typesetting. The former is an art, the latter is a trade. And in addition to the artistic differences, few novices realize that today's professional typesetting hardware has resolutions of thousands of lines per inch, unlike the laser printer's hundreds. Granted, that may change, but the basic principles of typography won't.

As a graphic designer and owner of my own firm, I'm all for good-looking output, but owning a desktop publishing system will not make me a designer any more than owning a Steinway will make me a pianist.

Brad Cathey
Wheaton, Illinois

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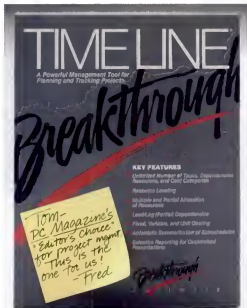
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■ LETTERS

REPUTABLE NETWORKING

It is obvious that Stephen Manes, author of "Networking: A Rocky Road" (*PC Magazine*, Volume 5 Number 14), has had only negative experiences and has never encountered a reputable systems house. I believe if he did more-thorough research he would find that there are many systems houses and integrators that are doing professional jobs in helping small businesses automate their operations.

Bruce R. Davidson
Information Inc.
Somerset, New Jersey

Stephen Manes replies:

The original draft of my column began with this disclaimer: "The following comments are not meant to reflect negatively upon all computer consultants, some of whom are actually hardworking, competent individuals and bulwarks of our nation's cherished freedom and independence." I edited it out because it seemed common knowledge. Guess I was wrong.

CONSULTANT CONFESSIONS

I just had to write after reading Stephen Manes's wonderful article "Confessions of an Unpaid Consultant" (*PC Magazine*, Volume 5 Number 13). As one who has been there more times than I care to count, I was delighted to read of a compatriot's trials and to see how similar our experiences have been. Keep it up, Steve!

Frances D. Mendelsohn
Rockville, Maryland

FOR YOUR USE ONLY

I have seen several program listings on public bulletin board systems that originally appeared in your Interactive Reader Service. Can I assume that since I have purchased the issue of *PC Magazine* that contains the original listing, I am within my legal rights to download these programs? Also, are users who key in the programs or download them from your Interactive Reader Service allowed to share those programs with other users? And finally, is it permissible to upload them by modem onto not-for-profit bulletin board systems, along with the statement indicating the source of the program?

Karen Rogers
Santa Rosa, California

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CORRECTIONS

VersaSoft's *dBMAN* was incorrectly categorized as a database compiler in "Project Database II" (*PC Magazine*, Volume 5 Number 12). *dBMAN* is in the same category as Ashton-Tate's *dBASE* product line. Also, *dBMAN* does offer user-defined capabilities and supports macros in programs and from the command line.

"DOS Gets Better—And More Expensive Too" (sidebar to "DOS to Travel," *PC Magazine*, Volume 5 Number 13) stated that *BASICA* 3.2 does not support the additional graphics modes of the EGA. This is incorrect; all the usual graphics functions of *BASICA* 3.2 work for all the graphics modes of the EGA.

In the article "DOS to Travel" (*PC Magazine*, Volume 5 Number 13), we incorrectly stated that the IBM PC Convertible uses only a 120-volt battery. The IBM PC Convertible uses a rechargeable battery.

The price of the Wisetek PC is \$575, not \$465 as stated in First Looks (page 35, *PC Magazine*, Volume 5 Number 14).

HOW TO WRITE TO PC MAGAZINE

Do you have a comment, compliment, or criticism about something you've read in *PC Magazine*? A question you'd like to open up to other readers? Then send your opinion on paper or disk to Letters to *PC Magazine*, One Park Avenue, New York, NY 10016. We're sorry we're not able to answer letters personally. All letters become the property of *PC Magazine* and are subject to editing. We cannot publish letters that do not include a name, address, and phone number for verification.

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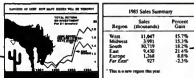
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Use all the printing features of your LaserJet with Polaris Ram-Resident PrintMerge

Ram-Resident PrintMerge gives you quick and easy access to all the LaserJet's powerful features — an editor which word processing, database or LaserJet-compatible graphics programs can use. With a few simple commands, you can turn a screen report into an exciting, visually appealing presentation. You'll be able to format text more vividly and program and combine it with the graphic output from any graphics program that can print on the LaserJet.

For instance, the chart on the left was created with Graphic Communication's Presentation and Graphics. Ram-Resident PrintMerge even prints properly aligned tables made up of any combination of proportional fonts like the table on the right.



You also get full access to all the formatting you've been missing with DisplayWrite 3, Multimate, etc. which include variations of any font, right justification of any combination of fonts, and a handy line and box drawing function. Plus, keyboard translation screens give you instant access to the LaserJet's foreign language and special purpose characters. Here's a small sample of words you can type without missing a beat.

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+2
Missouri

£125
Provincial
Munich

lallé
17 A
Glasgow

Be sure to ask about Polaris Crunch, a program that with Ram-Resident PrintMerge, Polaris Crunch automatically reformats files to suit the LaserJet's capabilities. It also resizes and crops graphic images which allows you to print only the images you want.

Read more about Ram-Resident PrintMerge below.

Justify any proportionally spaced text

Align tables printed with proportional fonts

Draw lines and boxes

Your software only lets you use a small fraction of the LaserJet's printing capabilities. Unfortunately, that also limits how precisely you communicate your message. That's why you need Polaris's Ram-Resident PrintMerge.

It's the only program that puts you in direct control of all the LaserJet's printing capabilities — so you control what your document looks like, not the limitations of your software.

You'll be able to add graphics right in the middle of your text. Use all the LaserJet fonts and extended characters whenever you like. And print it all beautifully with Ram-Resident PrintMerge's justification and line-drawing abilities. What's more, Ram-Resident PrintMerge works with the software you're already using, so it's very easy to learn.

Since Ram-Resident PrintMerge lets you merge graphics from virtually any program that prints on the LaserJet, you can reinforce complex ideas with illustrations right in the text. You can merge the graphic output or save a screen image, and merge either in any of four print resolutions. If your graphics are too large for your LaserJet to handle, try Polaris's Crunch, a separate program that compresses, rotates and trims images.

With the help of Ram-Resident PrintMerge's useful formatting features, your document

Runs Directly From:

DisplayWrite 3
Multimate
Freelance
Lotus 123
Paradox
NewWord
R:base 5000
Map-Master
WordPerfect
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WordStar
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Javelin
WordStar 2000
Framework
Easy
Microsoft Chart
PC Crayon
Sign-Master

and more

will be as impressive as its contents. You'll be able to use LaserJet fonts in any combination for more attractive, readable text. And justify right-hand margins and align table columns printed with proportional fonts — even if they're downloaded from diskettes. For extra emphasis, use Ram-Resident PrintMerge's line and box drawing capabilities and the LaserJet PLUS patterns to highlight important ideas.

And when you need to use extended or foreign language characters, Ram-Resident PrintMerge's five keyboard translation screens will put them at your fingertips instantly.

But even with all these features, Ram-Resident PrintMerge is truly easy to use.

Timesaving printer setup screens store nine sets of page parameters. Simply enter parameters for Lotus, dBase, or any other application program once, and use them again and again. "Ram-Resident"

means it loads automatically when you boot your system, so it's always ready. Just use your software as you normally would. When you need Ram-Resident PrintMerge's special features, set up the printer with one of the nine setup screens or key in the simple print commands right in your document.

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PFORCE Phoenix Function Festival

Lotus® didn't do badly pulling it all together in one place. Phoenix has followed with the ultimate unregretted C library, offering everything from low level functions for hardware access to complete tree database management. Along the way are prepackages such as string functions, time/date, field and screen editing, but also four styles of menus (Lotus included), windowing, background tasking, DOS interfaces, directory management, event driven screens, communications. Design emphasizes objects, so characteristics of windows, databases, records and fields can be mutated and changed outside functions.

One large collection in place of bits and pieces means one set of instructions and **Phorce®** has tutorials, extensive examples, quick reference, and on-line help.

Everything in source, to register all memory models of Lotus, **Msoft Specify 50220 & Compiler List #75, PCB #349**

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DAN BRICKLIN'S DEMO PROGRAM Storyboard Your Program

The Legendary One has created Metaphor Two when the set of us are all on Zero. Dan's best was the original, **Metaphor** (VisiCalc®). This one is for programers.

Words don't express program ideas because programs are screens! Dan's Demo creates slide shows. Create a screen — a snapshot of your planned product as it runs. Anything goes. Words, borders, box rules, inverse and underlining of monochrome, fore- and background color. Copy the "slide" to an empty screen. Change it a little, to show the next instant of run-time. Do it again. Presto, a whole slide show of your program in action.

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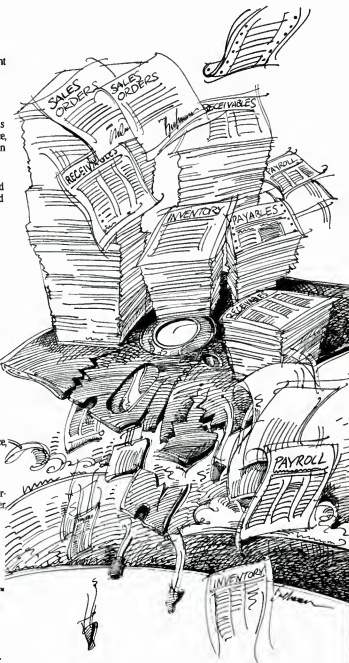
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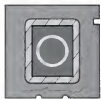
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PC ADVISOR



Help in preventing BASIC cross-machine incompatibilities and in selecting a macro program to use with Microsoft Windows—plus more on tracking PC use.

SOLVING BASIC INCOMPATIBILITIES

What is the difference between GWBASIC, Compaq BASIC, and IBM BASIC? About 90 percent of the computer work I do involves running programs I wrote in IBM BASIC on an XT. What will I have to do to get them to run on XT clones?

Richard Elliott
Costa Mesa, California

These BASIC interpreters were written to take advantage of the BIOSs in different PCs; they are roughly 99 percent compatible in that their syntax and commands are virtually identical. You can laboriously translate these hardware-dependent differences yourself in each program you write, or you can run them using a BASIC compiler that is compatible with all three: QuickBASIC, Version 2.0 (Microsoft Corp., Redmond, Wash.; (800) 426-9400; \$99).

You'll gain several benefits in addition to cross-machine compatibility: a full-screen text editor, helpful pull-down menus, and an interactive debugger to help you write and fine-tune your programs. And since you'll be compiling your programs, your finished work will be in the form of fast-executing .EXE files that can be run on any DOS machine.

USING MACROS WITH WINDOWS

I've grown increasingly eager to have the freedom of switching from one application to another that Microsoft Windows offers, but I don't want to give up SuperKey, which Borland International flatly says is

incompatible with Windows. Do you know of any popular keyboard macro program that's compatible—at least to the extent of being usable within a window?

Dennis Cheasebro
Seattle, Washington

SuperKey, and most other keyboard macro programs, work with applications programs that are running in the Windows environment; it's only when an application is running inside a window that the macros are disabled. Don't wait for a new macro program to solve this problem; if it is over-come, it will be Windows that changes.

CUSTOMIZED DATABASES

I've been looking for a database that has summary reporting (the ability to suppress detail records) as part of its standard reporting module. I have looked at products that require you to create a separate summary database and then to update it from

your detailed database. A flat-file database would be sufficient for my needs, but I need at least three Ctrl-Breaks. Can you help shorten my search?

Jim Vitkus

The level of customization you need is possible with just about any programmable database. Rbase System V (Microrim, Bellevue, Wash.; (800) 547-4000; \$700) and DATAEASE (Software Solutions, Trumbull, Conn.; (203) 374-8000; \$600) are both good. However, your needs are fairly simple, so ENRICH (Migent Software, Incline Village, Calif.; (702) 832-3700; \$395), a nonprogrammable database that allows very highly detailed report customization, could be your best choice.

MORE ON TRACKING PC USE

Last issue (Volume 5 Number 16), we recommended two programs to track computer time: Direct Access for simple, automatic logs, and Timeslips for professional invoices. We've just found a hardware solution: PC/Audit Trail, a half-size, PC- and AT-compatible card (Bay Computer Corp., Andover, MA 01810; (617) 470-3748; \$239). It stores logs in its own battery-charged memory and can monitor idle time in settings from 5 minutes to 2 hours.

ASK THE ADVISOR

Send your questions about hardware and software choices you are facing to the PC Advisor, PC Magazine, One Park Avenue, New York, NY 10016.

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Helpful Hints How loud is loud?

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CIRCLE 276 ON READER SERVICE CARD

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PC
 MAGAZINE

FIRST LOOKS

HANDS-ON EXCLUSIVE:

Compaq Deskpro 386 Ushers in 32-Bit PC Era

PC HANDS ON

AT compatible
and twice as
fast, \$6,499
desktop unit
packs minicomputer
power.

BY BILL HOWARD

The torch has been passed. Or at least fumbled by IBM and scooped up by Compaq.

At a price 20 percent higher than IBM's fastest PC AT, the \$6,499 Compaq Deskpro 386 runs twice as fast as an AT today and holds the promise of being as much as ten times faster next year with the development of multitasking software optimized to Compaq's 32-bit Intel 80386 processor.

The best way to think of the Deskpro 386, at the risk of trivializing an exhaustive year of development, is to imagine a box like Compaq's Deskpro 286—but with the 286 processor replaced by a 386 and 1 to 10 megabytes of static-column RAM (see sidebar, "Why Compaq Chose Static-Column RAM

Compaq's Deskpro 386 is targeted at power users, software developers, CAD, small business applications running under Xenix, as a network file server and for AI applications. Except for the 32-bit expansion slot used for 1-10 megabytes of static-column RAM, the Deskpro accepts most current PC and AT accessories. Available options include VGA graphics, a 130-Mbyte hard disk and an 80287 math coprocessor.



for the Deskpro 386") that feeds memory to the CPU in a 32-bit-wide path instead of the

8- and 16-bit paths of PCs and ATs.

(continued on next page)

First Choice Integrates Ease, Economy, Options

PC HANDS ON

BY ALFRED POOR

With prices for PC compatibles dropping almost daily, the base of first-time users is growing rapidly. At the same time, experienced users are pushing their PCs to new heights of sophistication.

To satisfy the demand for software powerful enough to realize the high expectations of these beginners, software publishers are pressed to deliver muscular programs that won't

break the budget of someone who paid less than \$1,000 for a system.

From Software Publishing, the champion of the novice user, comes *PFS:First Choice*, an integrated program for beginners. After building an empire with programs that traded off complexity for ease of use, the PFS people have crammed word processing, spreadsheet, file management, and communications features into a single tightly integrated unit for about \$150.

The program comes with an

excellent manual that is among the best we've seen. A 55-page tutorial, supported by a dozen sample files on the program disks, serves both to guide you through the exercises and to help you set up your own applications.

Fast Word Processor

The word processor is remarkably fast. Although if you type too quickly, it simply ignores the keystrokes that it can't handle. It automatically reformats and repaginates as you

(continued on page 35)

HANDS-ON INDEX

COMPAQ DESKPRO 386

First 32-bit PC arrives on the market **33**

PFS: FIRST CHOICE

Four applications, \$149.33

SAFETY NET

File insurance **36**

ALL ABOARD

EGA, EMS, and more... **46**

AUTOCAD 2.5

A few steps forward, one long step back **51**

THE TRANSLATOR

Converts Turbo code **52**

19-INCH MONITER DISPLAY

Sharp enough for desktop publishing **54**



Benchmark Tests: Compaq Deskpro 386 vs. IBM 8-MHz PC AT and PC's Limited 286 16

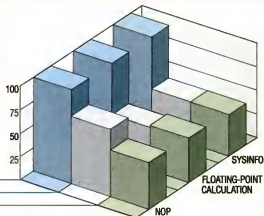
All times in seconds and decimal seconds. Graph shows results normalized against the IBM 8-MHz PC AT, where the AT's results equal 100.

The Floating-Point Calculation benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentials, and logarithmic and trigonometric functions. The test program uses the floating-point library included with Microsoft C 3.0.

Norton's Sysinfo is a widely used speed test that is sensitive to processors with pipelined architecture, such as the NEC V20 and the 68286.

The 128K NOP benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

Product	NOP	Floating-Point Calculations	Norton's Sysinfo
IBM 8-MHz PC AT	4.17	34.41	7.02
Deskpro 386	3.04	16.26	15.30
PC's Limited 286	2.09	16.72	15.17



Running software written for 8088-based PCs, the Deskpro 386 is about twice as fast as IBM's new 8-MHz AT and just about even with PC's Limited 286 16, which runs at the same 16-MHz clock speed as the Deskpro 386. It's expected that a 386 PC running 32-bit software could perform ten times faster than an AT.

Compaq 386

(continued from preceding page)

The 386 hard disks are bigger and faster (40 or 130 megabytes), a made-for-Compaq EGA monitor and EGA board are a \$1,400 option, the wimpy 10-megabyte tape backup option is now a more-muscular 40 megabytes, and the Compaq-trademark soft-touch keyboard has been expanded to 101 keys, the same as on the new PC AT.

Compaq added the new Microsoft InPort mouse connector that doesn't steal a serial port and wrote a software driver to emulate the Lotus/Intel/Microsoft expanded memory specification. Everything else is industry standard—seven of the eight expansion board slots; the serial, parallel, disk drive, and video I/O ports; and Compaq's "Rock of Gibraltar" ruggedness.

Compatibility Foremost

The Deskpro 386 is at once a daring step for Compaq and a conservative move. While the Deskpro 386 is the first 80386-based machine to get to market—beating even the "garage shops," as Compaq calls the PC's Limited crowd of computer manufacturers—it's built to be completely compatible with the 8088-based PC and the 80286-based PC AT. Compaq, remember, is the kind of company that, if IBM painted a green racing stripe on the side of its family of personal computers, would match the color exactly and add a protective clear coat for extra ruggedness.

Single 32-bit Port

Why just one 32-bit port? Compaq argues convincingly that I/O interfaces—printers, modems, monitors, disk drives—don't transfer data fast enough to require anything beyond the existing 8- and 16-bit data paths. True, the EGA can be a slug running through the 8-bit path IBM specifies, but future graphics cards may resolve the problem through a dedicated display processor, not a wider bus slot.

So rather than try to set a faster graphics standard that IBM would be sure to ignore, the \$599 Compaq EGA card (based on Chips and Technologies'

EGA CHIPSet) copies its ROM information into the Deskpro's faster 32-bit RAM memory. TTY scrolling is twice as fast as with other EGAs. Other EGA cards work in the Deskpro 386, but without the ability to relocate the ROM code.

Compaq believes the LIM expanded memory specification is more than a short-term phenomenon. The Compaq Expanded Memory Manager (CEMM) software utility allows extended memory to be used as expanded memory.

Why Compaq Chose Static-Column RAM for the Deskpro 386

To keep up with the speed of the Deskpro 386 processor, Compaq opted to use static-column RAM mounted on a 32-bit expansion card in slot 1 (not on the motherboard). The board holds 1 to 10 megabytes.

What's static-column RAM, and what were Compaq's other options?

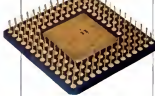
Static (not static-column) RAM is the fastest and usually the most expensive type of RAM available. Dynamic RAM, used on most PCs, costs less but is slower and must be periodically refreshed, which is an added overhead.

Caching is one technique whereby static and dynamic RAM are mixed to improve speed and decrease cost. Caching is used on all major mainframes, but it requires very fast static RAMs and complex support logic.

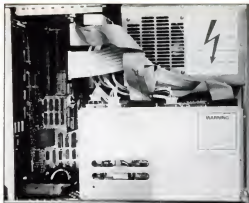
Data in a dynamic RAM is accessed by presenting the top (row) and then the bottom (column) half of a memory address. Static-column RAM is dynamic RAM that acts like a static RAM after the row address has been presented. An initial access takes the same time as dynamic RAM, but subsequent accesses are like static RAM operations.

Compaq chose static-column RAM because the 80386 uses an instruction queue that it tries to keep full. The combination of the 80386 chip and static-column RAM turns out to be very cost effective when compared with static RAM, dynamic RAM, or a cache-based system. It has most of the speed of a static RAM at the cost of a dynamic RAM.

—William G. Wong



The much anticipated Intel 80386 opens the way for larger RAM, faster processing speeds and true multitasking on PCs.



The Deskpro 386 box is much like the 286's, but it holds seven 16-bit expansion slots and one 32-bit slot. The model 40 includes a 40-Mbyte hard disk.

Compared to a PC AT, the Deskpro 386 accomplished most PC Magazine Labs benchmark test tasks twice as quickly. And while Compaq doesn't see PC's Limited as a marketplace rival ("I don't believe the 386 world is where people want to take a risk to save a few hundred or a couple of thousand dollars," says Compaq's president Rod Canion), the fact is that the \$2,995, 80286-based, 16-MHz PC's Limited 286 16 runs neck and neck with the Deskpro 386 on the benchmark tests. (PC's Limited is currently working on a 386 machine, but it's waiting to see what the Deskpro 386 is

like so it can have a target.)

The difference between 286 and 386 machines lies in the future, where software written for 32-bit chips could make 386 machines ten times faster than an AT. Compaq believes that software written for a DOS 5 protected-mode environment may be targeted only at 386, not 286, machines.

In addition to DOS 3.1 (patched to support Compaq's bigger Winchester), the Deskpro 386 will run on Xenix System V/286, which should encourage the porting of UNIX-based minicomputer software. Compaq is careful to say that the

machine has the power of a minicomputer in a desktop unit, rather than declare it an out-and-out mini. If Compaq is this careful, imagine how gingerly IBM will position its 386 entry to avoid cannibalizing System/38 sales!

In buying a Deskpro 386, you're getting incredible power

and capability while risking that IBM may do something different. But IBM is taking a risk, too, that any incompatibility with a DOS-standard 386 machine may cut IBM off from the user base of 6 million 8088- and 80286-based PCs. And even for IBM, that may be too big a risk. ■



FACT FILE

Compaq Deskpro 386 Model 40

Compaq Deskpro 386 Model 130

Compaq Corp.

20555 FM 149

Houston, TX 77070

(800) 231-0900

List Price: Model 40 with 1

Mbyte of RAM, 1.2-Mbyte disk

drive, parallel and serial ports,

101-key keyboard, 40-Mbyte

hard disk, \$6,499; Model 130

with 130-Mbyte hard disk,

\$8,799. EGA monitor, \$799;

EGA card, \$599; 1 Mbyte of

RAM upgrade kit, \$349; 4

Mbytes of RAM upgrade,

\$2,699; 1- to 2-Mbyte 32-bit

memory expansion board (with

1 Mbyte of RAM), \$849; 4- to

8-Mbyte memory expansion

board (with 1 Mbyte of RAM),

\$2,999; 8-MHz 80287 math

coprocessor, \$349; 40-Mbyte DC-2000 tape backup, \$799; second 40-Mbyte disk drive, \$2,199; 360K-byte disk drive, \$225; 1.2-Mbyte disk drive, \$275; amber monitor, \$255; Compaq mono/graphics display adapter, \$199; DOS 3.1, \$85; Xenix System V/286, \$599. Xenix Software Development System, \$599.

In Short: Well built and exceptionally PC compatible, the first 32-bit 386-based PC is a screamer. Its speed makes most ATs look like slugs. Additional speed gains await a new generation of DOS or UNIX software. Compaq's EGA card in the Deskpro 386 runs faster than anyone else's.

CIRCLE 437 ON READER SERVICE CARD

First Choice

(continued from page 32)

type, and shows page breaks on the screen.

The program makes some concessions to the novice user. You cannot search and replace for end-of-line carriage returns or strings of spaces. It defaults to overstrike mode (which I find that most beginners prefer), but switches to an insert mode. The mail-merge and spelling checker features are easy to use.

Slow Spreadsheet

The spreadsheet module is not as easy to use or as fast as I might have hoped. Entering formulas can be a chore. You can assign titles to cells, but that only helps somewhat. You can

copy one or more cells at a time, but only to a single destination; you cannot copy a cell into a range of cells. Some functions are slow; for example, the screen freezes for 3 seconds to jump to a new screen.

PFS:First Choice took 33 seconds to recalculate a 10- by 100-cell sheet, where top-level integrated packages take between 5 and 20 seconds, a speed that should be acceptable to beginners.

The spreadsheet does have some graceful features. It allocates a separate column and row for left-margin labels and top-row headings and allows long cell labels to spill into the adjacent cell and beyond. If the numeric contents of a cell are too large to fit, the column width

grows automatically so that you can see the entire result; you won't get a cryptic line of asterisks in your "total" cell.

One of the nicest features is the "quick key," which automatically enters a value or formula into a series of adjacent cells as fast as you can move the cursor through them. This is similar to copying a cell in most spreadsheets, but the real trick comes when you type the name of a month or day into one of the heading cells. Invoking the quick key with certain sequences allows you to fill in the subsequent cells with the other names in the sequence, again just by moving the cursor. Say "Jan," and it puts in "Feb," "Mar," and so on. Type "January" and it spells the months.

Easy Database

The database has some innovative features. You create the data entry form as if you were editing a document. Then you save it, and any text to the left of a colon is used as a field label. You do not have to define field lengths, types, order, keys, or other mundane and esoteric details required by other packages.

You can then open the "folder" and start adding records. If you fill up the space available between labels, the cursor will automatically advance to the next field. Alternatively, you can switch to insert mode and "push" the next label ahead; this makes the field contents practically as large as you want.

(continued on next page)

In*a*Vision "a marvelous little CAD system"

*Listen To What The Critics Are Saying About In*a*Vision*

PC Week

September 1985

"Stands out from the crowd." "It has the makings of a winner."

InfoWorld

February 1986

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PC Magazine

March 1986

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Computer Buyers Guide

March 1986

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Power. Versatility. Ease. All of these add up to performance. And performance is what In*a*Vision is all about.

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PC Magazine

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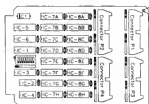
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PC Magazine

"The system is ideal for the kind of fine detail work that engineers, draftsmen and designers demand."

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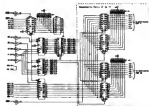
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Optional Clip Art library
(two diskettes) _____ copies at \$39.95 each.

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Card: ☐ Amer. Exp.

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Send to: MICROGRAFX, Inc. 1820 N. Greenville Ave. Richardson, TX 75081 In Texas: 214-234-1769	



Versatility!

"In*a*Vision's text provisions are flexible and impressive."

This advertisement was created with In*a*Vision and output at 300 DPL.

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CIRCLE 157 ON READER SERVICE CARD

Runs with or without Microsoft Windows on two-floppy or hard disk IBM PC or compatible with 320K; hard disk and 512K recommended.

■ PC UPDATE ■ PEGGY GAVAN AND DAVID GRAY

Ashton-Tate dropped copy protection from all its U.S. products. To discourage piracy, the nonprotected products will have custom sign-on screens requiring users to enter their name and company name at installation. The upgrade from *dBASE III Plus* is \$45 from Ashton-Tate, with sliding scales for quantity upgrades or upgrades from *dBASE III*. The company also initiated a series of programs to bolster support and service, including a \$4,000 Corporate Support Program, two plans for software maintenance, and four options for noncorporate support.

Lotus Development Corp. also dropped copy protection, but on a far more restricted scale. Corporate users of *1-2-3* who have a Lotus-approved antipiracy program and who upgrade 100 or more copies of *1-2-3* simultaneously will get an **unprotection disk**. Companies that previously upgraded 100 or more copies will also receive the disk. A similar plan will be in effect with the next upgrade of *Symphony*. Who's out of luck? Single users and companies that upgrade fewer than 100 copies at a time, even if the total exceeds 100. They'll still have to cope with copy protection or use

Peachtree Software bundled eight accounting software packages into one product, called *The Complete Business Accounting System*. Previously, the eight programs each cost \$595; the bundled package retails for \$199. Annual tax-code revision upgrades also cost \$199. The new ensemble drops the 90-day support plan in favor of a pay-as-you-go plan in which support costs \$1 per minute.

Leading Edge Hardware Products has added several features to its **Model D** personal computer, renaming it the **Model D Enhanced**. The \$1,495 PC-compatible now comes standard with 512K bytes of RAM, an internal modem, and a software package with word processing, a spreadsheet, and a spelling checker, plus dual 360K floppies and a monochrome monitor with Hercules emulation.

The **Software Link** has dropped copy protection from its **MultiLink Advanced**, Version 4.0. The new version increases the maximum number of users supported by one IBM AT or compatible from 9 to 17, allows **MultiLink Advanced** bulletin boards to run at 2,400 bits per second, and offers file-locking and color/graphics support. Upgrades are free to users who purchased Version 3.03 30 days prior to the Version 4.0 release and \$100 for others.

PopDrop, Version 2.0, from InfoStructures has a command extension to remove memory-resident programs with a batch file and a view command to display the space occupied by each layer of programs in memory. Upgrades of the \$19.95 program cost \$6.95, plus \$3 shipping and handling.

Monitors featuring **Zenith's flat-tension mask** technology, which markedly reduces glare, won't be available until well into 1987. Zenith announced the technology earlier this year and showed prototypes of the flat-screened monitors, including one version with a touch-sensitive screen, at the SigGraph convention in Dallas in August. But significant quantities won't be available until the second or third quarter of 1987, Zenith officials said. Later, the technology may find its way into TV sets as well.

In brief: Toshiba America will bundle Borland International software with its portables. The \$4,499 **T3100** will come with **SideKick** (\$84.95 retail) and **SuperKey** (\$69.95); the **T1100 Plus**, which sells for \$2,399 with 640K bytes of RAM and 1,999 with 256K, will now include **SideKick**....Personics Corp. is offering owners of Turner Hall Publishing's **Note-It** a trade-in deal on the program. Copies of **SmartNotes**, the \$79.95 screen-annotation program from Personics, will be swapped for a copy of **Note-It** and \$39.95. **SuperCalc** users who purchase Computer Associates' maintenance plan will receive a free upgrade to **SuperCalc**. The plan provides technical support, free upgrades, and emergency telephone support. Prices start at \$150 a year. **Brown Bag Software** is shipping Version 2.0 of the \$69.95 **Homebase**. Upgrades are \$34.95. **Micro Data Base Systems** will introduce **KnowledgeMan/2**, Version 2.01, by offering an optional bonus of \$325 worth of free software—**K-Mouse**, **K-Paint**, and **K-Graph**—to buyers. The price remains at \$695, with upgrade costs yet to be determined. **Two** additional font types have been added to **Enertronics' EnerGraphics**, Version 2.0, and will be shipped to all registered users at no cost. **Version 3.0 of The Spreadsheet Auditor** from Consumers Software has several new features, including interactive error checking, enhanced sideways printing, and no copy protection. Upgrades are free to users who purchased Version 2.0 between April 1 and August 1 and \$30 for other registered users. **Broderbund Software** upgraded **Bank Street Writer** to **Bank Street Writer Plus**. Enhancements include a spelling corrector, an on-line thesaurus, hard-disk compatibility, and pull-down menus. Upgrades cost \$30.

Copy Protection: Then and Now

Program	1 year ago	Today
Microsoft Word	•	
MultiMate	•	
WordStar	•	
WordPerfect	•	
R. base Series 5000	•	
dBASE III Plus	•	
Lotus's 1-2-3	•	
SuperCalc	•	
SideKick	•	
ProKey	•	
AutoCAD	•	
Flight Simulator	•	
• Yes		No

UNLOCKING SOFTWARE: The trend toward removing copy protection has accelerated in the last year. Curiously, AutoCAD is the only significant product to add copy protection. SideKick is the only one of the sample group that sells a copy-protected version at a lower price. Lotus has unlocked only for volume buyers.

third-party copy-protection strippers, such as Transec's **Unlock**.

Lotus also announced a series of support and training programs, called the **Multi-Value Plan**, and said it will offer unprotected versions of *1-2-3* to government agencies, such as the Department of Defense, which won't buy protected software.

Javelin Software Corp. removed copy protection from its **Javelin** business analysis and reporting software, effective with its first shipments of **Javelin**, Release 1.1. The program will flash custom sign-on screens to discourage software piracy. Added features of Release 1.1 include increased data-sharing capabilities, optional installation on networks, and 16 times the applications capacity of Release 1.0. Registered **Javelin**, Release 1.0, users can upgrade to Release 1.1 for \$20.

Maynard Has A Little Surprise For IBM PC Users.

Surprise,TM Maynard's new high-speed board increases your IBM PC's* speed up to 2½ times, and doesn't take up an expansion slot!



"I just calculated my Lotus spreadsheet in a fraction of the time it used to take! Maynard's new Surprise is fast!"



"I installed Maynard's Surprise even though I didn't have any expansion slots left! Was I surprised! Now my PC's faster than ever!"

*IBM PC and XT are trademarks of International Business Machines. Compaq is a trademark of Compaq Computer Corporation. HCR is a trademark of HCR Corporation. Prices for Compaq and HCR Model 4 are slightly higher.



"Maynard's Surprise jumps the PC's speed to 2.6 on the Norton SI scale! That's over 2½ times its normal speed!"

just

\$249!

suggested
retail price

- increases PC speed up to 2½ times!
- doesn't use an expansion slot!
- installs in seconds!
- works with the IBM PC and XT, Compaq, and NCR Model 4*!
- surprisingly low cost!



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CIRCLE 478 ON READER SERVICE CARD



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Tallgrass wants to put a bug in your system.

Introducing Grasshopper.® Fast,

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The Grasshopper is the bug you need. It is not a compromise. It is simply superior technology. That superiority gives you up to 40 Megabyte capacity with more capability, more absolute dependability than you will find elsewhere in the under \$1000 price range. Or any price range.

Automatic. It's not just the machine that's dependable. You can depend on people using it, too. The Grasshopper is alone in offering completely automatic, internal backup.

Every few minutes, at the times the operator is away from the keyboard, Tallgrass BackTrack® software will check your disk for changed files and automatically insert the changes on your backup tape.

That's just one of a half-dozen convenient, menu-driven backup options, but it's one that no competitor can offer.

Internal. It all comes in a very convenient package. The Grasshopper fits in a half-height floppy bay, and uses a data cartridge that fits comfortably in your shirt pocket.

Whether you need 20 or 40 Megabyte capacity, you get it with zero footprint. You can specify either capacity Grasshopper with a companion hard disk, and the Tallgrass



controller for both disk and tape plugs into a single slot.

The entire Grasshopper family is



internal tape backup for \$895.



available in compact external packages as well. And every system is covered by a one-year limited warranty.

Fast. The Grasshopper flies through backup functions with a 750 Kb/s data transfer rate, 50% faster than other budget alternatives.

Both the new 40 Megabyte storage system and the original 20 Megabyte Grasshopper offer logic circuitry

and software unique to Tallgrass.

So both also permit selective record updates on the backup tape, reducing time requirements to an absolute minimum. We even provide XTREE™ directory and file management software for both disk and tape, to help organize and find your data.

Totally reliable. Tape error detection and correction are unparalleled. In fact the probability of error is so small as to be statistically insignificant. Our unique Data Reconstruction Code™ means you know your backup will be there to back you up. Every bit of it.

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Others treat tape like a floppy disk. That shortcut is just too dangerous.

Tallgrass. There are a good many capabilities in the Grasshopper that no competitor can offer.

That's because Tallgrass Technologies developed QIC-100, the tape backup technology which has become an industry standard. And then kept right on expanding the lead.

The first time you call on tape backup you'll know how important absolute dependability is. We just want you to know how affordable the Grasshopper has made it. Call (800) 228-DISK for complete information, and the name of the Tallgrass dealer nearest you.



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NEW ON THE MARKET ■ PAUL M. STAFFORD



Portable Solutions' \$1,695 BP45+, a 60-megabyte external tape-backup system, is designed for portability.

Tape Backup: Irwin, Portable Solutions Offer 40- to 60-Megabyte Options

Two companies offer tape-backup solutions in the 40- to 60-megabyte range for customers with special needs.

For users with little desk space to spare, Irwin Magnetics is shipping its 400 Series Backup external tape system. Measuring 2 inches wide by 7 inches deep, the small-footprint series consists of the 10-megabyte \$799 Model 410 and 20-megabyte \$950 Model 420 for PC and XT compatibles and the 20-megabyte \$950 Model 425 and 40-megabyte \$1,095 Model

445 for AT compatibles. Traveling or multiple-machine backup needs are addressed by Portable Solutions' \$1,695 BP45+, a PC/XT/AT-compatible 60-megabyte external system that is designed for easy installation and portability. The BP45+ offers both file-by-file and disk-image backup and restore and comes with Survival menu-driven backup software and a 1-year warranty.

List Price: Model 410, \$799; Model 420 and Model 425, \$950; Model 445, \$1,095. Irwin Magnetics Inc., 2311 Green Rd., Ann Arbor, MI 48105; (313) 996-3300.

CIRCLE 427 ON READER SERVICE CARD

List Price: BP45+, \$1,695. Portable Solutions Inc., 1701 Directors Blvd., #250, Austin, TX 78744; (512) 448-4965.

CIRCLE 428 ON READER SERVICE CARD

Autodesk Sells Low-Cost Drawing Program; Files Compatible with AutoCAD

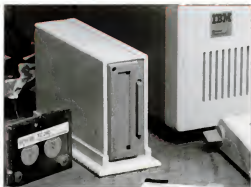
Autodesk, producer of AutoCAD, has announced a low-cost, low-end drawing package whose vector-based files are upwardly compatible with the computer-aided design package, AutoSketch, at \$79.95, offers full drawing and editing features (up to 256 layers), plus a user interface that includes pull-down menus and dialog boxes.

AutoSketch supports IBM's CGA (in monochrome) and EGA standards, as well as the Hercules Monochrome Display Adapter. Output devices include any Hewlett-Packard or Houston Instrument compatible plotter, as well as some dot matrix printers.

List Price: AutoSketch, \$79.95.

Requires: 384K RAM, compatible graphics card and monitor, mouse. Autodesk Inc., 2320 Marinship Way, San Rafael, CA 94965; (415) 332-2344.

CIRCLE 433 ON READER SERVICE CARD



Priced from \$799 to \$1,095, Irwin Magnetics' 400 Series tape-backup units are small-footprint, 10- to 40-megabyte systems for PCs,XTs, and ATs.

Seattle Computer Ships Seattle-DOS 3.1; Identical to MS-DOS 3.1

In one of the more offbeat recent product announcements, Seattle Computer announced the availability of its version of DOS 3.1, Seattle-DOS 3.1. Seattle-DOS 3.1 is identical to its Microsoft counterpart in all but a few respects: the BIOS, a few

advanced utility programs, and the \$35 price tag.

The original creators of DOS obtained a terrific deal for their creation, sort of: a perpetual, royalty-free license for all past and future versions of DOS as part of its original sales agreement with Microsoft. The catch? Seattle Computer can legally sell DOS only to purchasers of its hardware, which must include a CPU. Seattle Computer solves that by offering a \$20 8088 or 8086 CPU module, the one-time purchase of which entitles customers to all future DOS updates.

List Price: Seattle-DOS 3.1, \$35; CPU module, \$20. Seattle Computer, 7649 S. 180th St., Kent, WA 98032; (800) 331-0246; (206) 251-0246 (in Wash.).

CIRCLE 438 ON READER SERVICE CARD

HOT PROSPECT

Lowest-Priced 80286-based Computer Ever: \$995 SAM 3001 from HiTech International

AT-compatible computers just broke the \$1,000 price barrier. HiTech International has introduced the 80286-based, \$995 SAM 3001. Featuring switchable 6- and 8-MHz clock speeds, the SAM 3001 also includes 640K bytes of on-board

RAM, a 1.2-megabyte floppy disk drive, two serial ports, one parallel port, and a CGA-compatible color/graphics adapter (but no monitor). Also available for \$1,595 is an enhanced version that includes a 30-megabyte hard disk and an amber monitor as standard equipment.

List Price: SAM 3001, \$995; enhanced model, \$1,595. HiTech International, 1180-M Miraloma Way, Sunnyvale, CA 94086; (408) 738-0601.

CIRCLE 426 ON READER SERVICE CARD

HiTech International's \$995 SAM 3001 is the first 80286-based AT compatible to cost less than \$1,000.



Smart Communications Controller Features Call Logging, Security

Computer Accessories' \$499.95 Private Access is a smart communications manager that connects between PC and modem, controlling system access, logging calls, and allowing remote power-on-and-off. Designed for any application where remote access to a PC or network is required, Private Access can be programmed for as many as 100 users, each with

passwords and access levels. These users can call in and enter their user name and password, and Private Access can be set to power up the PC and call them back.

Also able to log all incoming and outgoing calls, Private Access works with any Hayes-compatible modem and can be accessed through any standard communications software.

List Price: Private Access, \$499.95. Computer Accessories Corp., 6610 Nancy Ridge Dr., San Diego, CA 92121; (619) 457-5500.

CIRCLE 431 ON READER SERVICE CARD

Two Companies Debut 386 Software Development Systems: Assembler, LISP

Gold Hill Computers has introduced two bundled products based on Intel's 32-bit 80386 CPU: a 386-based XT- and AT-compatible plug-in card for software designers and a LISP implementation that takes advantage of the chip's advanced features.

The 386 HummingBoard and GCLISP 386 Developer package, at \$7,000, is aimed at software developers who want to get a jump on developing expert-system and artificial-intelligence applications to run on forthcoming machines.

Running at a clock speed of 16 MHz, the 386 HummingBoard contains 6 megabytes of

RAM using 256K-bit RAM chips and can be expanded to up to 24 megabytes using 1-megabit chips. Both configurations address memory via a 32-bit data path. The GCLISP 386 Developer can directly address up to 16 megabytes of RAM and includes a LISP compiler, an editor, and a tutorial.

Also available for forward-thinking software developers is Phylap Software's \$495 386/ASM package, an assembly language development system that is compatible with macro assemblers for the entire 8086 line of CPU chips.

List Price: 386 HummingBoard and GCLISP 386 Developer, \$7,000. Gold Hill Computers Inc., 163 Harvard St., Cambridge, MA 02193; (617) 492-2071.

CIRCLE 429 ON READER SERVICE CARD

List Price: 386/ASM, \$495. Phylap Software Inc., 60 Aberdeen Ave., Cambridge, MA 02138; (617) 661-1510.

CIRCLE 430 ON READER SERVICE CARD

Palantir Software Writes Database Program to Work With Microsoft Windows

Adding to the recent flood of products designed to work under Microsoft Windows' graphics-based operating system interface, Palantir Software has announced *Windows Filer*. *Windows Filer* lets *Windows* users



CalComp's \$6,045 1041GT is an eight-pen D-size plotter that features automatic pen-capping and nonvolatile setup memory.

CalComp Unveils Fast Eight-Pen D-Size Plotter for CAD and Engineering Applications

CalComp's \$6,945 1041GT eight-pen roller-bed plotter, designed for CAD and engineering environments, accommodates A- to D-size paper or film. Featuring a claimed plotting speed of 24 inches per second, acceleration of 1.2g, and resolution of 0.0005 inches, the

1041GT uses automatic pen-capping techniques and nonvolatile setup memory.

List Price: \$6,045. CalComp, 2411 W. La Puma Ave., Anaheim, CA 92801; (714) 821-2142.

CIRCLE 432 ON READER SERVICE CARD

create custom data-entry forms and reports, perform calculations, do complex sorts, and combine graphics with data. *Windows Filer* can also share data with other *Windows* applications and can perform tedious, time-consuming tasks like sorts and indexes of large

databases in the background under *Windows*.

List Price: \$145. **Requires:** Microsoft Windows. Palantir Software, 12777 Jones Rd., #100, Houston, TX 77070; (713) 955-8880.

CIRCLE 434 ON READER SERVICE CARD

Okidata Expands Dot Matrix Printer Line to Include Nine-Pin and Dual Nine-Pin Models

Okidata is shipping three additions to its popular Microline series of dot matrix printers.

The Microline \$499 80-column 192 Plus and \$749 132-column 193 Plus replace Okidata's \$699 192 and \$499 193 nine-pin line of printers. Both printers feature four print modes: a new high-speed draft, which Oki-

data rates at 200 characters per second; a utility mode, rated at 160 cps; an emphasized/en-

hanced mode, rated at 80 cps; and a near-letter-quality mode, rated at 40 cps.

Both printers also feature both platen-pin and single-sheet paper feeds, front-panel menu-selectable IBM Graphics Printer and Proprinter emula-

tion, and Okifont font-selection software.

Okidata claims actual throughput speeds (as opposed to maximum printhead speeds) of up to 120 lines per minute at 136 characters per line, or 272 cps, for its \$1,499 Microline 294. Achieving this speed using dual nine-pin printhead technology, the 294 emulates other printers through plug-in personality modules; one module is included in the purchase price.

List Price: Microline 192 Plus, \$499; Microline 193 Plus, \$749; Microline 294, \$1,499. Okidata, 532 Fellowship Rd., Mt. Laurel, NJ 08054; (609) 235-2600.

CIRCLE 426 ON READER SERVICE CARD



Okidata's \$1,499 Microline 294 is a high-speed, wide-carriage dot matrix printer with a dual nine-pin printhead. Okidata claims 272 characters per second of effective throughput for this unit.

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Gen Word Chart	82
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In-A-Vision	249
Microsoft Business Mouse	106
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Microsoft Serial Mouse	119
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CWA	Call
DAC Easy Accounting	Call
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■ COMMUNIQUE ■ EDITED BY BILL HOWARD

Roses Are Red, Violets Are Blue, I Love You More, Than My CPU

Tired of overly sentimental greeting cards featuring furry animals or tanned couples with flawless complexions strolling into the sunset? Thoughtware Expressions lets you set your own hallmarks for good taste with a series of do-it-yourself greeting card programs.

These programs include *CardWare* (\$9.95), which makes greeting cards; *HeartWare* (\$9.95), an "animated friendship greeting disk and love-note maker"; and *PartyWare* (\$14.95), which makes invitations and decorations.

Thoughtware Expressions Inc. (2699 S. Bayshore Dr., #1000A, Coconut Grove, FL 33133; (305) 854-2318) is the company that came out last year with *JingleWare*, a \$9.95 holiday greeting card package.



Dot matrix romance: *HeartWare* lets you assemble your own greeting cards.

XT Expander Packs EGA, EMS, Ports and More

PC HANDS ON

BY WINN L. ROSCH

Less means more in multifunction boards: the less room each on-board component takes, the more functions fit into a slot.

Using ultracompact surface-mount technology and clever programming of an internal Z80 microprocessor, IDEAssociates has maximized the potential of the expansion slot, packing its All Aboard card with a powerful combination: EGA adapter, hard disk controller, serial port, parallel port, and clock.

And if that's not enough, you can fit up to 2 megabytes of Lotus/Intel/Microsoft expanded

memory on an optional daughtercard, making a two-board stack that is a full slot long and just under 0.8 inches wide. A version that drives RGB color and TTL monochrome displays is available.

Installation consists of two steps: matching jumpers with the display mode and type of display (color, monochrome, or EGA), and choosing your options with the setup program.

The 9-pin monitor output and parallel port are mounted on the All Aboard retaining bracket; the serial port is on a separate bracket tethered to a cable. For composite output, All Aboard has an 8-inch wire with an RCA jack, which slides through a re-



Back to the drawing board: Microsoft Press's 1,053-page DOS Encyclopedia has a few bugs to work out.

But It Only Costs a Penny an Error

How many errors can you find in this excerpt from the long-awaited *MS-DOS Technical Reference Encyclopedia* from Microsoft Press?

For example, to sort a directory by date, type

A>dir | sort \ + 25

Answer: three. The backslash should be a forward slash, the date begins in column 24 of a directory listing, and this command won't sort by date because DOS doesn't display dates in year-month-day format. Here's the punch line:

Joke of the Week

Two aging programmers, wondering about the existence of computers in heaven, agree that whoever dies first will send a report back to the other.

True to his word, the first programmer to die returns several days later with a report:

"I've got good news and bad news. The good news is that there are computers in heaven and I've been having great fun writing programs."

"So what's the bad news?"

asks the second programmer.

"You start a hot new project Monday."

The \ + 25 switch means "all files created or changed after the 25th."

Not quite what you'd expect from a book by the publisher of DOS, with a foreword by Bill Gates and a price tag of \$134.95. Shortly after a *PC Magazine* writer called with questions about these and other errors, Microsoft recalled the 1,053-page guide for major surgery. If you have a copy, you can return it for a refund or keep it as a collector's item.

taining bracket notch.

The hard disk controller supports a number of readily available and relatively inexpensive ST506-standard hard disks with capacities ranging from 10 to 30 megabytes, including Seagate models ST212, ST213, ST4026, and ST4038; Tandon TM252, TM262, and TM502; and Rodime RO202E and RO203E. The All Aboard supports only one disk, and you have to supply your own hard disk connecting cables.

Overall, All Aboard may be the easiest and cheapest way to deck out a bare XT as powerhouse. It works in other IBM models, but its 8-bit bus short-changes the AT's abilities. And, its hefty power consumption (surface-mount technology by itself doesn't cut the electrical drain) and inability to allocate its RAM between DOS and

PC FACT FILE

All Aboard

IDEAssociates Inc.
35 Dunham Rd.
Billerica, MA 01821
(617) 663-6878

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\$545; with EGA, \$795; daughterboard with OK, \$200

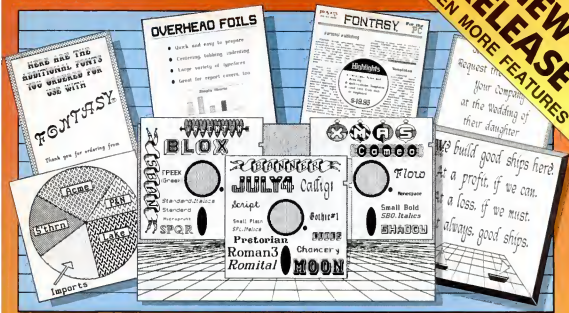
Requires: IBM PC-XT or XT compatible.

In Short: An easy-to-install multifunction board that includes a serial port, parallel port, clock, hard disk controller, monochrome/EGA/EGA compatibility, and 2 megabytes of optional EMS.

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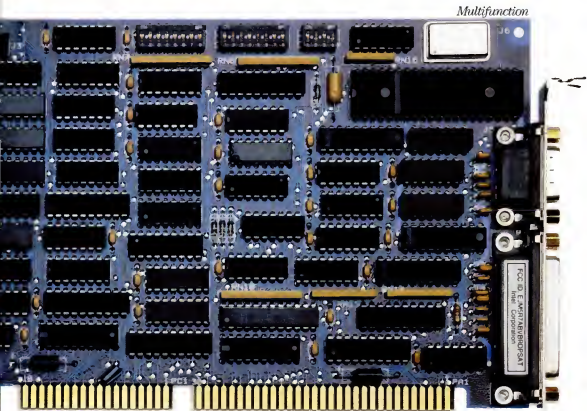
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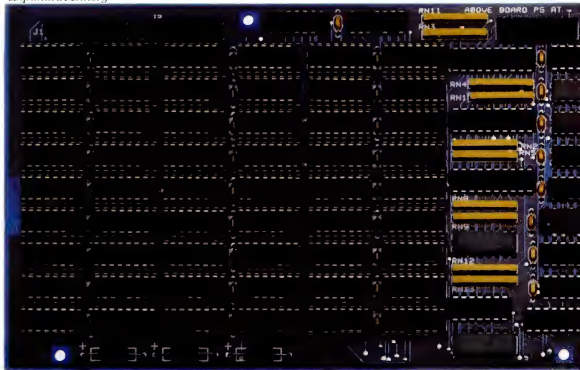
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- Programmers and software vendors can use Remote to debug a client's software by phone, without leaving their own offices.

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AutoCAD 2.5 Adds 70 Features And Copy Protection Hardware

PC HANDS ON

Time-tracking, extended memory support, and Dynamic Zoom are among the changes.

BY GLENN HART

Autodesk's AutoCAD has built an enviable market share as the leading microcomputer computer-aided design program. Now, a major new release, Version 2.5, takes one step backward by adding copy protection, but it adds over 70 new features as well.

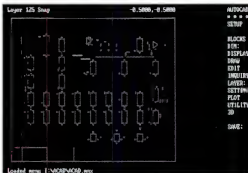
Autodesk has chosen to protect Version 2.5 with a hardware device inserted into the COM1 serial port (see sidebar "AutoCAD's New Albatross"). 2.5 can access LIM-type expanded memory or AT-type extended memory for faster disk accesses. A new time-tracking system, which keeps a running log of the time spent working on an image, is useful for billing. Updates are being sold to registered users for the difference between the cost of their version and the \$2,750 cost of 2.5.

When you send in your registration, Autodesk returns a laminated template for your digitizing tablet. While not quite up to some third-party templates, it will suffice for most users.

The AutoCAD interface is basically unchanged, with the traditional hierarchical on-screen menu system. A new "Pickbox" has been added to make selecting objects easier.

Circles, Polygons, Donuts

The circle system has been expanded to create circles tangent to two lines, circles, or combinations. Polygons of 3 to 1,024 sides can be drawn. Do-



The addition of improved editing features has slowed AutoCAD's initial screen draws, although redrawing during editing is considerably faster.

nuts are filled circles or donut-shaped, and ellipses can now be drawn directly.

The Text command now includes a useful Fit option that fits text between two points while keeping character height constant. More important, a Dtext option shows text on the screen as it is entered and allows simple editing.

Several image-editing commands have been improved and some new ones added. For example, a marvelous Stretch command stretches entities by moving endpoints within a window to a new location. This can move an existing door, for example, while leaving all its connections intact.

AutoCAD no longer ties entity color or line type to a layer (although you can still work that way if you wish). Trim and Extend allow cutting and extending entities in several creative ways. Fillet now works with circles and arcs as well as lines. Offset constructs an entity parallel to another entity, though it still can require more steps than in CADs that make parallel lines a primitive drawing entity.

Expanded Undo Option

Version 2.5's undo capabilities have been greatly expanded. Undo now can backtrack through the entire drawing data-

base, reversing the action of your commands one at a time. Other useful options let you Mark a step or Group a sequence of commands; these options let you experiment and re-

PC FACT FILE

AutoCAD, Version 2.5

Autodesk Inc.
2320 Marinship Way
Sausalito, CA 94965
(415) 332-2344
List Price: \$2,750
Requires: 640K RAM, AT or compatible with math coprocessor and hard disk recommended.

In Short: This update adds many new features and an obtrusive hardware protection device.

CIRCLE 423 ON READER SERVICE CARD

turn to the original image if you don't like the results.

A nifty Dynamic Zoom feature combines Pan and Zoom and lets you choose the area you want to examine with interactive on-screen windows. In some circumstances, this is faster and more convenient than previous methods (which are still available).

(continued on next page)

AutoCAD's New Albatross

The AutoCAD disks are not themselves copy protected, but the program looks for the presence of the hardware lock when it starts and throughout program operation.

Autodesk claims that the lock shouldn't cause problems with other programs but points out that there "can be difficulties." The documentation blithely suggests moving your peripherals around. My standard configuration wouldn't execute at all with the lock in place, so the lock is clearly not transparent.

If the lock fails, Autodesk will replace it only if the defective one is returned, and you'll be down while you wait. If the device is lost or stolen, you'll have to pay the full \$2,750 price for a replacement. The company blandly suggests insuring it.

Autodesk has grown tremendously without protecting its software. While it may be concerned about networks and other multiple-copy situations, in my opinion, its protection scheme is a step backward and a significant negative for AutoCAD, Version 2.5.

—Glenn Hart

This 3½-inch key plugs into a serial port and should allow free use of the port by other devices, although it did not prove transparent during testing.



Translator Smooths Upgrade From Turbo Pascal to Modula

PC HANDSON

Logitech hopes to entice programmers with its \$49 tool for converting Pascal source code.

BY NEIL J. RUBENKING

Programmers who feel cramped by Turbo Pascal's limits and aren't swayed by its speedy compilation and compact code may be wooed away from the program now that Logitech's *Turbo Pascal to Logitech Modula-2/86 Translator* ensures that the Pascal code they have written won't be lost when it's converted to Modula-2.

Borland International's Turbo Pascal currently owns the low end of the PC programming market, with more than half a million copies of the program in circulation. Logitech, a mouse manufacturer, hopes to dethrone Turbo Pascal by offering a powerful, low-priced tool that will aid Pascal programmers in making the transition to Logitech's Modula-2 programming language.

Logitech is banking on the similarity of the two languages; both were written by Niklaus Wirth. Modula resembles a refined Pascal and allows separate compilation of program modules. This process lets Modula programmers build a library of

common routines and link them easily into larger programs.

Split-Screen Translation

The *Modula-2/86 Translator* (written in Modula-2) is smooth and well documented. Translation proceeds on a line-by-line basis, with Pascal and Modula-2 source code appearing simultaneously in an impressive split-screen display. The program marks such areas as sets, strings, and typed constants that require hand editing.

Turbo Pascal users can ease the process by rewriting programs before translation, eliminating potential trouble spots and using only the most straightforward string manipulation. Only fully debugged Turbo Pascal programs can be translated.

A substantial portion of the manual explains what to do if the *Modula-2/86 Translator* flags errors or if the translated

program won't compile. It also charts the relationship between Turbo Pascal identifiers and their Modula-2 counterparts. Logitech provides special modules for routines, such as file input/output, that are normally implemented very differently from their Turbo counterparts. Graphics routines of IBM Turbo Pascal are converted so smoothly that the Modula version of a translated "bouncing balls" graphics program required no hand editing at all.

The *Modula-2/86 Translator* failed only once during testing. It consistently omitted the required empty parentheses after one library procedure that caused a series of compiler errors.

Logitech accurately calls its Modula-2/86 programs a "software development system." Besides the built-in advantage of separate compilation of modules, it includes source-code debugging and a large code



This split-screen display shows how the Turbo Pascal program at left is converted to Modula-2 source code modules, which can be compiled separately later.

PC FACT FILE

Turbo Pascal to Logitech Modula-2/86 Translator

Logitech Inc.
805 Veterans Blvd.
Redwood City, CA 94063
(415) 365-9852
List Price: \$49

Requires: 256K RAM,
Logitech Modula-2/86 Base
Language System (\$89), Turbo
Pascal, DOS 2.0 or later.

In Short: A practical and useful
way to convert Pascal source
code to Modula-2, though
subject to certain stated
limitations.

CIRCLE #21 ON READER SERVICE CARD

(greater than 64K bytes) program model. These features are not available from Borland (though third-party vendors provide some of them).

Not for Hobbyists

Programmers who have never used a full-scale development system like this may find it cumbersome. Indeed, the success of Turbo Pascal is based in no small part on speed and modest code size. The Turbo editor/compiler takes 38K bytes on disk—with all the trimmings (E087 support, Binary Coded Decimal math, and graphics), it still leaves about half a floppy disk free for user programs. Logitech's Modula-2/86 with all of its trimmings fills half of a 10-megabyte hard disk.

Weekend programmers are unlikely to have the resources to use Modula-2, but the *Modula-2/86 Translator* lets the serious programmer move to Modula-2 without sacrificing any work done in Turbo Pascal.

AutoCAD 2.5

(continued from preceding page)

Is It Really Faster?

Benchmark-testing CAD programs is a complex task, but I couldn't resist taking a quick look at Autodesk's speed claims. What I found was a bit surprising.

Our first trial loaded the drawing editor, drew a complex schematic full of very small text, and redrew the same image. AutoCAD, Version 2.18, took 50 seconds, while 2.5 needed 1 minute and 38 seconds. This was caused by different management of very small text. I then tried zooming to a

small corner. The old version took 24 seconds for the initial zoom, while 2.5 did it in only 2 seconds.

On several graphics-only images, 2.5 was consistently 7 to 15 percent slower than 2.18 in drawing the initial image, owing to the overhead of creating the 32K- vs 32K-byte virtual

screen, which makes any subsequent zooming and panning you may want to do much faster with 2.5.

Overall, Version 2.5 is a significant advance over earlier releases. Putting aside the annoying copy-protection device, the new features justify the cost of upgrade.

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19" Viking 1 Displays Tack-Sharp B&W Images

PC HANDS ON

BY GLENN HART

Tired eyes will brighten at the sight of the Viking 1 system from Monitorm. This 19-inch black-and-white monitor with a full-length adapter card that feeds off a mono or CGA card, provides 1,280- by 960-pixel resolution for crystal-clear display suitable for CAD and desktop publishing work.

Running *AutoCAD* or *Microsoft Windows* under the drivers provided by Monitorm, the 19-inch black-and-white monitor displays a tack-sharp image, and the 11-inch by 14-inch raster size is a delight to eyes sore from squinting at 12-inch displays. The monitor image is quite readable, and it proved easy on my eyes even over extended work sessions.

Powerful Controller Chip

Viking 1's secret weapon is the powerful Hitachi HD63484 Advanced CRT Controller chip. This incredible chip is a generation ahead of video controllers like the NEC 7220s, which are fine devices but don't provide the graphics primitives and hardware bit blit (a display-memory swapping technique) that the Hitachi chip has. The HD63484 acts as a graphics coprocessor, freeing the CPU for other tasks, while it rapidly draws screen images.

And rapid is the right word for the Monitorm system. It writes to the screen at a blazing 110 MHz—many times faster than most other video systems. When you consider that over 81 million dots must be drawn each second (1,280- by 960-pixel resolution times 66-Hz screen refresh), the Viking 1's stratospheric speeds are a welcome change from high-resolution video systems that poke along at a leisurely pace.

Viking 1's interface card draws its power from the moni-

tor—an excellent idea that prevents too much power from being drained off the PC's power supply. The early production sample I examined didn't want to run any faster than 6 MHz in a variable-speed AT, but Monitorm promises to remedy this in current production.

Bigger and Better

The Viking 1 is about \$600 more than Wyse's fine WY-700 1,280- by 800-pixel black-and-white system. The devices share much in common, but each has trade-offs besides the cost. The Wyse offers gray scaling that makes it a bit easier to use with standard color software, but the resolution on the Monitorm is higher. The biggest difference, though, is the screen size. Very small characters and graphic elements are easier to distinguish on the Monitorm, and the overall ease of viewing is higher. The Viking 1 is the same display sold with Sun workstations.

Drivers for *Microsoft Windows* and *AutoCAD* are now included with the Viking 1, while drivers for *I-2-3* (in both text and graphics modes), other CADs, *GEM*, *Halo*, and other software are under development by Monitorm. Monitorm is also working on a driver that will allow any "well-behaved" DOS application to use the full screen.

You can also connect the monitor alone to a standard monochrome, Hercules graphics or color card (but not an EGA card at the moment). You can use your existing monitor in a dual-screen configuration or have the Monitorm monitor display everything.

Frame Grabbers

The Viking 1 uses frame-grabbing techniques to acquire and digitize the output from a standard PC video card. It displays the video output from DOS and applications programs

PC FACT FILE

Viking 1

Monitorm Inc.
5740 Green Circle Dr.
Minnetonka, MN 55343
(612) 935-4151

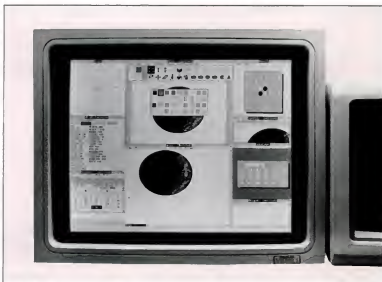
List Price: \$2,395

In Short: A superb high-resolution black-and-white video system with a sharp 19-inch monitor.

CIRCLE 422 ON READER SERVICE CARD

in the central upper portion of the screen, occupying about two-thirds of the vertical dimension and half of the horizontal display space available. When used in this way, the display is acceptable but unspectacular, and there is no color-to-gray-scale conversion.

The Viking 1's \$2,395 price certainly isn't cheap for a black-and-white video system, but it is so superior to smaller and slower systems for the coming generation of graphics-intensive software that many critical users will find the extra cost well worthwhile.



Running *Microsoft Windows* on the Viking 1 it's possible to step back from the screen for perspective and still see the display clearly—an important consideration for desktop publishing. For comparison, a standard 12-inch display sits at right.

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outer

QuadEMS+ "The Right Way To Do Memory"

Stewart Alsop, PC Newsletter

Computer experts are praising QuadEMS+ as the smartest new memory product for the IBM Personal Computer. With the QuadEMS+ package from Quadram you extend the life of your personal computers with increased power and capability. QuadEMS+ turns even old PCs into top-of-the-line performers. It's the fast, cost-effective way to make the most of the PCs you've got.

Compatibility

Only QuadEMS+ delivers both EMS and EEMS on one board. This way you're ensured of full software compatibility under each standard. QuadEMS+ is the risk free answer when you move up to expanded memory.

Installs Itself

QuadEMS+ is so smart it even installs itself. There are no switches or jumpers to confuse you. You just plug it in, press a key, and it does the rest, automatically configuring itself to your system. QuadEMS+ makes moving up to expanded memory a snap. What could be easier?

With QuadEMS+ you can access large amounts of data quickly, run large programs in expanded memory, instantly access multiple programs, and eliminate idle waiting time with concurrent processing. QuadEMS+ is the right way to add memory to your system.

For more information on the board the computer experts are praising, visit your local computer dealer and ask about QuadEMS+. Or contact us at One Quad Way, Norcross, Georgia, 30093, 404-923-6666.

Productivity

Concurrent PC DOS XM comes as a bonus with QuadEMS+. It supports expanded memory and multitasking so you can run up to four of your favorite DOS applications at the same time without modification. Its windowing capability, programmable function keys, and menu-driven design make Concurrent PC DOS XM easy to use.

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SQZ! Cuts Lotus Files Down to Size

BY CHRISTOPHER BARR

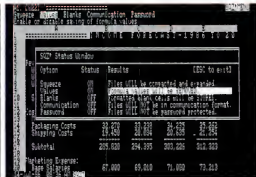
If you use *1-2-3* or *Symphony* and are running out of disk space, here's a solution that costs much less than upgrading to a bigger hard disk drive. *SQZ!* from Turner Hall Publishing is a RAM-resident program that squeezes your spreadsheet to a fraction of its original size before saving it to disk.

Turner Hall claims *SQZ!* compacts the average spreadsheet to 15 percent of its original size. My tests showed a sizable compaction but not quite 85 percent. Most files slimmed down by 70 to 75 percent. A normal worksheet that was 162,190 bytes reduced to 45,651 bytes—a 72 percent reduction. While using expanded memory, I created a 321,690-byte worksheet and then reduced it to 89,758 bytes, or 28 percent of its original size.

Optimizing Options

The *SQZ!* menu has several options that allow you to choose how you want files to be saved (print and graph files cannot be compacted): Values, Blanks,

Communications, and Password. Whereas *1-2-3* and *Symphony* will save both a cell formula and the resulting value, *SQZ!* allows you to save just the formula with the Values option, thus saving additional storage space. *1-2-3* and *Symphony* also store cells that contain blanks, even though blanks often do not need to be saved. When you use its Blanks option, *SQZ!* does not store the blanks, further reducing the worksheet's size. With the Communications option, the file is reformatted from a binary to an ASCII text file, which is good for transmission over an



This is the menu that Turner Hall Publishing's \$79.95 *SQZ!* drops on top of your spreadsheet. Using a 1-2-3-type command, you can change any of the options.

electronic network. The Password option lets you assign password protection to your spreadsheets.

Once you load *SQZ!*, it remains RAM resident as you

work. Although Turner Hall claims it's compatible with many memory-resident programs, *SQZ!* crashed *1-2-3*, Release 2, repeatedly until I removed *SideKick* from RAM.

G-Spell: \$9.95 Spelling Checker

BY VICTORIA DANOFF

What can you buy for under \$10 these days? Nothing much, that's for sure—certainly not a hardcover book on *The New York Times*'s best-seller list or a year's subscription to *PC Magazine*. You can buy a barebones spelling checker, though: Pico Publishing's *G-Spell*, which sells for \$9.95.

G-Spell might have one target market: starving writers with an above-average vocabulary who know how to spell most of the words they use and mainly want to be able to spot types. *G-Spell*'s 90,000-word dictionary will do the spotting and they can do the correcting—what more can you expect for \$9.95?

To be fair, *G-Spell* isn't really all that bad; it even marginally resembles Simon & Schuster's \$59.95 *Webster's New World Spelling Checker* (see "English Types with Spelling Checkers," *PC Magazine*, Vol-

ume 4 Number 26). And, actually, up until you start asking *G-Spell* to help you "correct" spelling errors, everything seems too good to be true: the price is great; the documentation (two files on the master disk) reads well; the installation is easy; there are no bothersome menus or commands to learn; and—the best feature—the program checks for errors without your having to monitor it.

The trouble starts when *G-Spell* tries to correct your errors. A Pico representative admitted that the program can help you with misspellings "only if one letter is missing"—quite a limitation. *G-Spell*'s error-correction "thinking" process seemed to take forever during testing, but *G-Spell* did offer *germane* for *germain* and *personnel* for *personal*. Unfortunately, it gave up on too many others without even one try.

G-Spell doesn't offer *Webster's New World*'s nice preview option, but you can have

all the misspellings put in a separate file. I like the simplicity of *G-Spell*—to call it a barebones spelling checker program is not to exaggerate—but I wish it used function keys instead of letter keys for commands. One nice feature is that you can add as many customized dictionaries as you wish.

If all you really need is a spelling error detector, and not a corrector, you can't lose with *G-Spell*. Otherwise, you'd be better off laying out the cash for a more helpful spelling checker program.

PC FACT FILE

SQZ!

Turner Hall Publishing
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9607

List Price: \$79.95

Requires: 1-2-3 or *Symphony*, DOS 2.0 or later.

In Short: *SQZ!* is a RAM-resident utility that compacts spreadsheets to use less disk storage space. Crashed *1-2-3*, Release 2, with *SideKick* installed. Not copy protected.

CIRCLE 628 ON READER SERVICE CARD

PC FACT FILE

G-Spell

Pico Publishing
P.O. Box 3266
Jamaica City, LA 52244
(319) 354-5736

List Price: \$9.95

Requires: DOS 2.0 or later.

In Short: A barebones spelling checker that quickly detects spelling errors but does little about helping you fix them.

CIRCLE 629 ON READER SERVICE CARD

PC-Write Improves with Age

BY J.H. SMITH

Ignore for a minute the fact that it's distributed via shareware: for \$75, *PC-Write*, Version 2.6, is one heck of a bargain. It's easy to learn and use for most tasks; and it can do a lot.

PC-Write has greatly improved since Version 2.55 (see "The Business of Words," *PC Magazine*, Volume 5 Number 2 for a review). Embedded "rulers" no longer limit you to a single margin setting throughout your document. Also new is automatic reformatting, which works quickly. The package now includes 40 customizable help screens and lets you interactively redefine the keyboard to your liking.

Simple and Fast

Common operations are easy and quick. Block moves, copies, and deletes couldn't be simpler; neither could writing to disk, quitting, nor changing files. Deleting words and transposing characters involve single-character commands. You can create footnotes, tables of contents, indexes, and other advanced formatting niceties. *PC-Write* creates ASCII files that any program can read, unless you want to add font-control characters or any of the 128

IBM special characters.

PC-Write still has a major limitation: it can't edit files more than 60K bytes long. It's got no support for columns and tables. Some dot commands for advanced formatting are unintuitive and obscure. *PC-Write* seems to insist on putting a space at the end of every line. And it doesn't have a spelling checker (the \$89 Version 2.7 will).

Registration Bonus

Quicksoft will send you a complete *PC-Write* distribution disk with limited documentation for \$10. For \$75, you get the software, full documentation, two free updates, and a year's telephone support. You can give the distribution disk away to anyone. If you're regis-



PC-Write, Version 2.6 (\$75), adds embedded rulers that let you set variable margin widths, automatic reformatting, and customizable help screens (not shown).

tered, you'll get \$25 when they register, too.

This is also the ultimate site license. You'll need to provide all your users with distribution disks (free if you copy them yourself) and manuals (with quantity discounts available from Quicksoft). You can buy

telephone support for users who need it (with quantity discounts). It's cheap, and employees can use the software at home.

Unless you can't live with its limitations, take a \$10 gamble on the *PC-Write* distribution disk. How can you go wrong?

Missing Link Fills Port Shortage

BY WINN L. ROSCH

Not so long ago, if you had a modem and a mouse and wanted to connect a serial printer, you were out of luck thanks to the personal computer's inability to output to more than two serial ports. But Henson Scientific has solved the serial port shortage and along the way created what is probably the best way to connect a serial printer to your PC: a 5-inch-long expansion card called *The Missing Link*.

The Missing Link is a special serial printer adapter that fools your PC and most software into thinking it is an ordinary parallel printer adapter. In DOS nomenclature, it functions like a COM port but behaves like LPT1, LPT2, or LPT3 ports, making your PC think your serial printer is an ordinary parallel printer.

Unlike the IBM asynchronous adapter, the communications parameters of *The Missing Link* are hardware- (rather than software-) defined. Word

length, parity, baud rate, and handshaking are all set by on-board jumpers (DOS's MODE command cannot change these hardware settings). You can even alter some pin assignments to match the requirements of various printer manufacturers.

The Missing Link supports all common printer protocols (XON/XOFF, ETX/ACK, and DTR/hardware) and handles them transparently within the confines of the expansion card. Neither you, your system, nor your software has to worry about any of them.

Not an Ordinary Adapter

The Missing Link will not function as an ordinary communications adapter, though. It connects only to printers, not to modems and mice. This restriction is a result of IBM's parallel port design, in which parallel ports can communicate in only one direction: to the printer. The printer is restricted to only a handful of dedicated signals that it can send back to its host com-

puter, for instance, ready and paper out.

Again, unlike the standard IBM asynchronous communications adapter, *The Missing Link* functions as a DCE (data communications equipment) rather than a DTE (data terminal equipment) device. What this means is that a serial printer connected to *The Missing Link* uses an easier-to-make (and, you hope, cheaper) straight-through cable rather than a "null modem" cable required by the IBM adapter.

PC FACT FILE

PC-Write, Version 2.6

Quicksoft
219 First Ave. North, #224
Seattle, WA 98109
(206) 282-0452

List Price: Distribution disk, \$10; full program and documentation, \$75

Requires: 256K RAM, DOS 2.0 or later

In Short: Like fine wine, this shareware favorite improves with age. It now includes automatic reformatting and more. Not copy protected.

CIRCLE 622 ON READER SERVICE CARD

PC FACT FILE

The Missing Link

Henson Scientific Inc.
490 West End Ave.
New York, NY 10024
(212) 769-3322

List Price: \$189.95

In Short: A half-length serial-printer-only adapter that looks like a parallel adapter to your system and may just be the easiest way to connect a third serial device to a PC.

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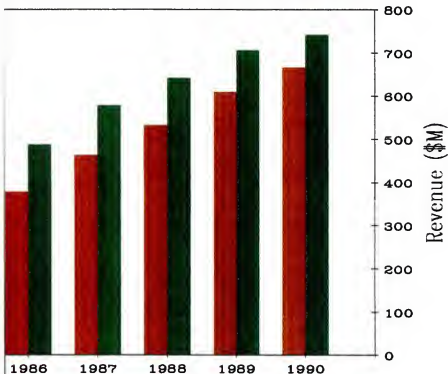
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Downloading a mainframe application? ECM memory runs with any program that uses DOS for screen services including RM and MS FORTRAN and MS and LATTICE C! This means you have an additional 384K available for oversized applications. Programs which write directly to the screen require a simple patch to adhere to the new standard. MicroWay has already developed patches for the Lotus, WORDSTAR and AUTOCAD screen drivers. Release 1A of 1-2-3 jumps from 535,516 to 916,444 bytes available and runs faster than Release 2 for most worksheets.

Number Smasher/ECM is 100% compatible with all hardware and software including EMS and EGA boards. The compatibility is a result of control: its speed is switch, keyboard or software selectable from 4.77 MHz to 12.0 MHz. Applications which have not been upgraded to ECM can still be run by setting DOS to 640K or 704K and using the memory above DOS for I/O enhancers.

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CIRCLE 139 ON READER SERVICE CARD

■ FROM THE EDITOR'S SCREEN ■ BILL MACHRONE

THE STRONG GET STRONGER

Prosperity in the computer industry has taken a new tack. Performance and price stratification are the ingredients of success.

Diversification. It's the word on every computer industry CEO's lips. And it's reaping surprising benefits for the savvy user.

Industry pundits have delighted in taking to task software and hardware manufacturers alike for being one-dimensional, or not being able to come up with that second big product. It's an easy criticism—almost a cheap shot.

The litany reads like an indictment of the entire industry: Lotus can't come up with a *J-2-3* successor. IBM moves too slowly and fails to utilize new technology. The *PFS* series is played out. The clone makers are fast-buck opportunists. We're at the mercy of the Japanese. Compaq is caught in a price/positioning squeeze and has nowhere to stand. And so on.

Lotus is always first on everyone's list of "yeah, but what have they done lately?" criticisms. Sure, *Symphony* didn't replace *J-2-3*, and Lotus hasn't pushed *Sportlight*, *HAL*, or *J-2-3 Report* as effectively as it might have. But I, for one, am through knocking *J-2-3*. Release 2, for being a flawed successor to 1A. Lotus has now shipped more copies of Release 2 than Release 1A, and I refuse to believe that it's just shelfware. Corporate customers everywhere are biting the bullet and recoding their 1A models for Release 2. It's the new standard. Might makes right.

Nonetheless, Lotus is keeping a weather eye on Microsoft's *Excel*. If you want to know what features *Excel* will have on your PC, look at it on a Macintosh. It's a winner. *Excel* has also clobbered *Jazz* in that arena, but Lotus doubtless has an an-

swer up its sleeve. Meanwhile, Lotus has broken meaningful new ground in its traditional stronghold, the financial community. In my travels, I've seen a lot of Lotus's *Signal* stock-quote receivers sitting on PC ATs. Lotus is gearing up for a big entry into the scientific and engineering market, which will mesh nicely with the coming generation of PC-based workstations. *Excel* may ace *J-2-3* on the first serve, but watch for Lotus's answering volley.

PLAYED OUT When the critics say that the *PFS* series is played out, they're right. The line was phenomenally successful. It fit a time, a range of capabilities, and a set of user expectations that don't exist anymore. But my hat is off to Software Publishing Corp. for some shrewd acquisitions and earnest product development.

The new low-end product, aptly named *First Choice*, is actually integrated software. It offers a word processor, spread-

sheet, filer, and communications. Each function is menu driven, with drop-down menu selections, on-line help, and handsome, helpful screens. At its \$149 list price, *First Choice* is a lot of software for the money.

Software Publishing's new Harvard product line dovetails nicely with *First Choice*, as a high-priced line. Its new Professional line is in another, higher price tier. The Professional line is especially noteworthy because it includes a networking package that takes any of the Professional series products and adapts them to network operation. There's even a specialty line, with its own pricing and market, in the *ClickArt* series of desktop publishing applications. Any resemblance to General Motors' product stratification strategy is not entirely coincidental. The opportunity for trade-ups and add-ons is built in. I think it's a winner.

TANDY POWER What other company could roll out five new computers at once? Sure, some of them are variations on existing machines, but they are at the same time indications of health and commitment. Tandy literally has something for everyone, and you can find it in your neighborhood. Tandy has capitalized on the resistance engendered by the cookie-cutter compatibles built in the Far East. Tandy chairman John Roach repeatedly calls them "the no-name transient clones" in his litany. He's implying (and saying outright) that Tandy will be here next year and 5 years from now, while the importer/distributor may not.



Illustration: Kent Williams

■ FROM THE EDITOR'S SCREEN

As persuasive as this idea is, it's even more significant that Tandy has pulled all the weird machines from its product line and left us with a machine for every purpose, all compatible. Tandy is making a

strong statement at the top end with the 3000 HD. The 3000 already offers more expansion slots than any other 80286-based machine, and the new model offers one of the fastest hard disks around. Its ap-

pliability as a file server or multiuser machine is obvious.

At the other end, the new members of the 1000 family are determinedly easy to use. The all-in-one 1000 EX comes with *Personal Desk Mate*, a simplified version of the original *Desk Mate* program. This new version looks like a character-based version of *Microsoft Windows*. The 1000 SX comes with *Desk Mate II*, which is powerful and easy to use. It's only Tandy's latest volley in becoming market savvy. You can buy all of the mainstream software packages at a Tandy computer center now, a far cry from the days when all of the stores' software was privately labeled.

NAY SAYER Despite Tandy's protestations, you can buy a lot of computing power for a good price if you judiciously shop the clone market. You buy with John Roach's warning in your ears: If it breaks and it turns out you've bought a disposable computer, so be it. It was great while it lasted.

The upshot of this latest change in the market is that you have more-discriminating choices to make when you're selecting or specifying machines, especially if you're a first-time user. It's more and more like buying a car. You have your choice of "engines," "transmissions," and "accessories." You can pick a machine with a fast 8088 with confidence and save the money that you would have spent on an 80286. Not only can you select disk capacity, but you can also tune access time to your needs.

And just when everyone was saying that integrated software is dead, two significant new packages show up. Both *First Choice* and *Desk Mate II* are aimed squarely at the first-time user. Both work better than many of the equivalent standalone packages. The big difference is the price. While \$149 for *First Choice* isn't bad for a product of this caliber, Tandy is giving away the same functionality. Of course, there's a catch—you have to buy a Tandy 1000 to get *Desk Mate II*.

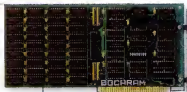
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Christopher O'Malley,

PERSONAL COMPUTING, April '86

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Winn L. Rosch, PC MAGAZINE, May 27, 1986

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■ JOHN C. DVORAK

WYSIWYG MANIA



In our frenzy for "what-you-see-is-what-you-get" page layout, we become slaves to our documents instead of letting the computer do some of the work. Is this progress?

There is something subtly insulting (not to mention annoying) about a computer that beeps at you when it thinks you've made a spelling error. The on-line spelling checker is a classic misuse of computer power—to me, it marks the end of the blind fear and blatant hatred of the dreaded batch process. Spelling checking is better done as a batch job rather than a word at a time; let's face it. The frenzied trend away from batch peaked with what I like to call What-You-See-Is-What-You-Get Mania. There is nothing sacred about WYSIWYG, but you'd never know it if you talked to many of today's users.

Once upon a time, all computers were batch oriented. Everything was done at once, usually from piles of punched cards that were dropped off at some central site where arrogant computer gurus nested. Terminals were unknown. We communicated with a klunky keypunch machine—if you call that communicating.

One day someone discovered multiuser systems and distributed processing. Programs could be entered into a terminal and executed on the spot. The minicomputer companies pioneered this technology and everyone went bananas. Gosh, it was fun to get your own prompt on the screen. Too bad you had to wait so long for it. There was always some huge batch job running in the background, slowing up the system. There it was again—the evil batch job.

Ah, the next generation creeps up on us. Look! It's a personal computer. No batch job to screw up the response. It's mine! Mine! MINE!

Mania sets in. Power-hungry users de-

mand more and more of the computer. It's under complete control of the user now. *Control* is the operative word. Power hungry and crazed, the users fall into a rut. Soon they begin marching and chanting, "What you see is what you get. What you see is what you get."

Some are lured by slick salesmen showing icons and mice. "Lookit this, kid! Let me show you *Pagemaker*. Look at this. What you see is what you get."

"Yes, yes," say the users as they slobber all over the keyboard. "Wow!"

Yes, wow. Wow, until you find yourself stuck at the terminal for hours on end so you can get it "just right." Soon you stop eating and become antisocial. Days, weeks, months pass. Your life is a shambles. It's a sad tale.

BETTER THAN WYSIWYG This tale of woe comes to mind because I discovered that Hewlett-Packard is secretly

working on a version of ANSI standard SGML, sometimes known as the Standard Generalized Markup Language. This is a system to code documents in such a way that any number of formatter programs can read the document, understand the codes, and produce typeset copy. In no way is it a WYSIWYG system. It's portable, it's universal, and it's batch.

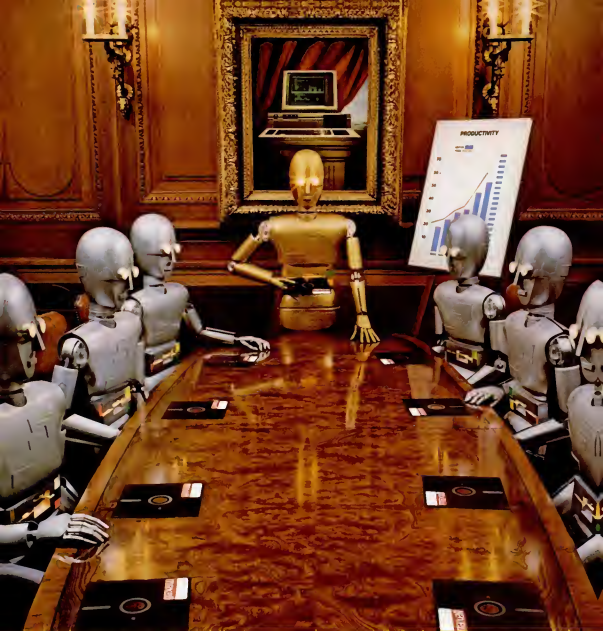
I realized that when you're working on a 100-page document, you don't want to lay out each and every page with a WYSIWYG program. It would take forever. This lets the computer do the work. There's nothing wrong with that, is there?

Even the best WYSIWYG standalone typesetters use some sort of copy markup language for long text. As with a Pascal program, you state your variables at the beginning of the run. You tell the machine what will be the body copy, what will be the headlines, what typeface to use, how much space between lines, stuff like that.

WYSIWYG is more fun than cryptic codes, but it is also more work. Moving around a page and changing every little detail on the screen until you get it "just right" is a misuse of computer power. With WYSIWYG page layout, we've managed to turn the computer into a drafting table, a pair of scissors, and a pot of glue. Talk about reverse engineering.

Pagemaker and other desktop publishing programs are marvels, true. But let's not forget that batch has advantages. As much as we like our terminals, we don't want to die at them. Like Groucho once said, "I like my cigar, but sometimes I like to take it out of my mouth, too."





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INSIDE TRACK

The HP 150's touch-sensitive screen may not have been a huge success, but Hewlett-Packard hasn't given up on the idea of infrared linking.

Once upon a time, Hewlett-Packard produced a computer with a **touch-sensitive screen**. It was called the HP 150. HP still makes the little machine, but now the touch-screen is an option.

The HP 150 used a **grid of infrared beams** to detect the location of a finger pointing to the screen. It was an interesting idea. They once had an ad for the product showing a butterfly landing on the screen and executing a command. I always figured that in reality a **big housefly** would land on a screen and by roaming around for a few moments erase half the disk.

Well, HP kind of gave up on that device as a big winner, but it didn't give up on infrared as a way to transmit data. Its new pocket **super calculator, the 18C, connects to its little printer via an infrared link**. Forget about RS-232 cables. This is the way to go. While the infrared keyboard used by IBM on its overpriced PCjr met with mixed reviews, most of us have to admit that cables are a pain in the butt. Watching a little printer magically print data from an infrared link is both **eerie and exciting**. If the printer of the future has enough intelligence, the data can go back and forth like an Xmodem transfer, so even an interruption of the beam won't result in lost data. **Look for infrared data links as a big winner in the years to come**. Now about that cable manufacturer you were about to invest in. . .

FREE PRODUCT-IDEA DEPT.

While on the subject of Xmodem, here's a project for someone. Design a product called Xmodem-interactive, or Xmodem-i. It seems to me that you should be able to download a file from someone

and converse (via typing) at the same time. Very little data is transmitted in a conversational mode over a phone link, and surely a file transfer can pause once in a while. **Do you have any product ideas** that you want to give away in hopes some guy will make the product so you can use it? Send your ideas to me c/o PC Magazine. I'll print the best ones.

While on the Subject of Hewlett-Packard, I keep forgetting to retell this anecdote. At **Spring Comdex in Atlanta**, the HP booth people kept telling showgoers to go to the IBM booth and **have them drop an IBM PC Convertible just a few feet**. The HP guys would then drop the HP portable from about six feet with no ill effects. "If you don't think you're going to drop a portable computer once or twice in its lifetime, you're fooling yourself," they said. IBMers, meanwhile, would not drop a Convertible for anyone.

Here's an **interesting item** that showed up on the wire services: IBM accounts for 40 percent of worldwide revenue and 70 percent of the profits of the computer industry. Does that tell you something about profit margins and success? It tells me that I can get a better deal somewhere else.

Perhaps the better deal comes from Texas-based **PC's Limited**. Yes, Virginia 12-MHz PC's Limited AT clone is not only **faster than prunes through a duck**, but well designed, too. All my wizards tell me the same thing. It's a superb design and probably the most **underrated** machine out there right now. Worth serious consideration.

The company that is feeling its oats in the compatible business, though, is **Tandy**. According to a recent Gartner

Group analysis, the Fort Worth firm should **surpass IBM in market share for PCs** in sales to businesses that do less than \$500 million a year. According to Gartner's research, IBM's market share of 45 percent will dwindle to 24 percent by this time next year, and Tandy will grow from 24 percent to 30 percent. Give the Taiwanese and Korean clone makers another 30 percent.

LOTUS WATCH What did Lotus ever do with **TK!Solver** when it had **TK!Solver**? **TK!Solver**, for those of you who aren't familiar with the product, is what I like to call a **crooked bookkeeper's dream come true**. It allows you to reverse calculate. In other words, you can put in the answer you want and the program will make changes to other numbers. It does a lot of other things, too, and is a "must" program for any engineer or financial type of guy. The algorithms for this **nontrivial product** were developed by unsung genius Dr. Milos Konopasek. Konopasek was **disappointed** in both Software Arts' inability to market the product and Lotus's similar blundering. "At one time, Lotus wouldn't even ship a copy to a customer. They just didn't know what to do with it," Konopasek told me.

Asked what Lotus did with the **purchase of Software Arts**: "Nothing as far as I could tell," said Konopasek. Dan Bricklin claims they did use some software, but he wouldn't say what. "I'm under nondisclosure."

The only thing I could figure out is that they took the proprietary **Software Arts Implementation Language** and did some coding with it. That obscure language has been dropped by Konopasek at his new company. "We're using C," he said.

The new and improved **TK!Solver** is available from **Universal Technical Systems** in Rockford, Illinois, for \$250. An upgrade is a mere \$50. Call the company at (815) 963-2220. Have fun. ☐

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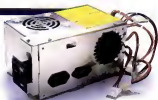
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MicroSystems Journal,
January/February 1986

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PC Magazine,
February 25, 1986

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PC Week,
August 13, 1985

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■ PETER NORTON

WAITING FOR THE NEXT LEAP FORWARD



Norton ponders some fundamental questions about the future of the PC family: Who's in charge? What's IBM doing? Where's the PC heading? Should you be concerned?

It was over lunch at the Harvard University faculty club that they put the question to me. "We just equipped the entire department with ATs. Do you think it was a wise move?" What they really wanted to know was, would they get fired for buying those machines?

I always hear such questions with trepidation. Since I'm supposed to be a PC guru, people expect me to have all the answers. So I'm often faced with lots of questions that I can't answer; lots of times they're big questions that don't even have answers.

This time I was in luck: I knew the answer. They were in luck, too: they'd made the right move—their jobs weren't in jeopardy.

WHITHER THE PC? But even though I was able to give a simple answer, the question was really quite deep and complex. To answer it, you need to consider the larger issues of "Whither goest the PC family? What's IBM up to? Who's in charge of the PC?"

The reason the issue gets so complicated is that, as everyone knows, however quickly the computer universe changes, change occurs even more rapidly in the personal computer realm. Barely a year elapsed from the time of the introduction of the original all-floppy-disk PC to the appearance of the hard disk XT. And just a year after that, the stunningly fast AT came onto the scene. In the meantime, we've seen the appearance and disappearance of the PCjr, the spectacular rise of Compaq (the quickest-ever rise of a com-

pany from start-up to Fortune 500), and so forth.

Paradoxically, we also seem to be in a remarkably long period of calm. We saw the PC, XT, and AT introduced roughly a year apart. But since the AT's introduction more than 2 years ago, nothing has come along to surpass it. Thus, the next big technological step is long overdue. Not only that, everyone has a pretty good idea of what that step is supposed to be—the new generation of PCs based on the Intel 80386 microprocessor (as the PC was based on the 8088 and the AT on the 80286).

From this perspective—a history of rapid change, and the obvious technology for the next jump forward—it would seem clear that things are poised for that leap that would make all our PCs and ATs obsolete. But . . . it ain't necessarily so.

What is true is that before long we'll see some hot 386 machines, probably sooner than I would have predicted (just as the

286-based AT appeared exactly a year sooner than I thought it could). And it is also true that we're going to see some advanced operating systems (DOS 5 or whatever) that will make both 286 and 386 machines do phenomenal things. But, the most important thing is (*drumroll*) it doesn't matter (*cymbal crash*).

FROM SUCCESS TO FIASCO Why doesn't it matter? For the same reason that, from IBM's point of view, the PC has gone from spectacular success to utter fiasco.

Everybody knows about the spectacular success. It was quick to happen and obvious to everyone. IBM unveiled the PC very timidly (offering machines with no disk drives and a ludicrous 48K, in case people just wanted BASIC Tinkertoys), but the PC immediately raced far beyond IBM's best hopes. The PC has grown so much that it contributes not a sliver but a significant fraction of IBM's gross revenues.

The fiasco is emerging more slowly and isn't quite so easy to see, but, from IBM's vantage point, it's certainly ominous.

You see, IBM is used to being in charge of its customers. IBM mainframe salespeople had an old saying, "Don't let the customer get in charge of the account"—meaning the IBM salesperson tells customers what they need and what they'll buy. Heaven forbid that customers should make up their own minds. It was all accomplished with skilled sales management and subtle manipulation.

That sales technique was easy enough to use when IBM had tens of thousands of



■ PETER NORTON

very corporate and very executive customers. When IBM told those customers that their old machines were obsolete, they bought new ones. It all worked pretty darned well.

With the PC, though, things are different. First of all, the customers don't number in the tens of thousands, but in the millions. (Before long, in fact, it'll be tens of millions.) And those millions of people

don't have executive manners—they're feisty consumers.

Those millions of PCs out there have created a tremendous inertia that is all but impossible to overcome. Nothing on earth is going to get all those people to replace their machines with something else just because it's newer and more wonderful.

PCs AS COMMODITIES And that's just the half of IBM's nightmare. The other half is that, as we all know, the PC has become a "commodity," which means that we no longer have just the original IBM brand along with a few others, like Compaq and Tandy; we now have zillions of

■ We're going to see some advanced operating systems that will make 286 and 386 machines do phenomenal things.

brands of PCs, plain and fancy, cheap and dear—all of them able to run Lotus's 1-2-3 with no sweat.

Thus, while you and I may deliberately choose to pay more for some of the subtle quality that we get from IBM and Compaq, the typical consumer has learned that a generic PC is just fine for his or her needs and can be a whole lot cheaper. In fact, you and I have discovered that, too. (My office now has as many cheap Epson Equity II as top-of-the-line ATs and Compaq 286s.)

All this has led to a tremendous change in the relationship between PC users and IBM. Many of us may have started out with a strong respect for and loyalty to IBM. But when we find all those great deals on PCs with brand names like Leading Edge, Epson, and Tandy and discover that these machines can actually run all that great PC software out there, you can bet we no longer have much loyalty to IBM. There may be a warm spot in my heart for IBM, but not in the hearts of the majority of cost-conscious PC buyers.

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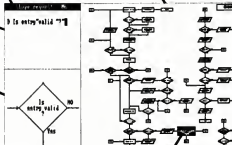
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SHAPE CURSOR shows where you are in the chart. Cursor keys move it around; chart window scrolls if you run off the edge of the window.

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VIEWPOINTS

■ PETER NORTON

And so, the reins controlling the PC family have passed from the hands of IBM into the hands of the consumer. Naturally, this is bad news for IBM; you can expect to see the company looking for a way to evolve the PC away from its commodity status and back into a proprietary IBM-branded product.

But I don't think that it can be done except in a very limited way, such as in targeted specialty markets—rather like the way the RT PC is a specialty member of the PC family.

THE GOOD NEWS For the user, all this means that the PC as we know and love it has stabilized into a familiar and reliable part of civilization. It's a lot like the layout on a typewriter keyboard—it may not be the greatest, but everybody knows how to use it, so it's not going to change much.

So if a good friend or relative asks your opinion on whether to buy a PC or wait for something newer and better to come

■ The reins controlling the PC family have passed from the hands of IBM into the hands of the consumer.

along, you could feel safe recommending that he or she go ahead and buy one and get the benefit of having it today, secure in the knowledge that it won't be rendered obsolete tomorrow.

You could also feel safe betting your job on a recommendation to stock your office with ATs, like my friends at the faculty club.

So whither goest the PC family? Onward and upward, but not so far or so fast that it leaves the vanilla PC and trusty old software like *WordStar* behind. What's IBM up to now? A desperate and failing effort to regain control of the PC family. Who's in charge of the PC? You and I, buddy, not IBM.

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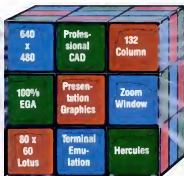
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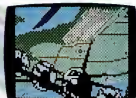
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■ JIM SEYMOUR

THE DECLINE OF THE CENTRAL OFFICE

Downtown office-space developers are likely to find themselves out of luck as companies cut employees' commuting time with networks of PC-connected suburban satellite offices.



One of the standard allegories used by futurists is the image of a people living on the upper reaches of the Amazon. Nurtured by the great river, the society is bound to it by generations of cultural ties: puberty rites, birth ceremonies, death rituals.

Their existence is whole and complete. Tribespeople may never have traveled more than a mile from a village, but they know all they need to survive and prosper in their world.

But then, let us imagine, the government of the nation that includes that stretch of river decides to build an enormous hydropower development a few miles upstream or downstream of their village.

It does not matter which: If upstream, the surging river flow past their village will be reduced to a trickle, and the continual soil-enriching flood cycles of years past will be no more. If downstream, an enormous lake will rise behind the dam, flooding their village and driving them to higher ground on the banks of a vastly different body of water.

In both cases, their culture, tied so closely to the river, is forever changed by a force they could not anticipate and which they are utterly unable to cope with.

They have been blindsided by a phenomenon outside their experience.

A LURKING DANGER Something similar lurks in the wings for developers of office space in American cities. Already beset in many areas by low-occupancy rates, giveaway lease rates, and other curses of overbuilding, these developers hardly

need any more bad economic news.

The villain they face is the rapid advance in the PC's telecommunications capabilities, aided and abetted by executives' and professionals' growing disgust with long commutes, downtown parking costs, and the inflated cost of inner-city prime office space. This phenomenon is one example of the ways PCs and related technologies are changing the ways we live and work. And it betrays a growing sense among managers and workers that more and better van-pooling arrangements, diamond express lanes for commuter buses, and staggered working hours may not be the wave of the future.

Some legal, accounting, and engineering firms, for example, are already actively questioning whether offices in downtown high-rise bank towers are worth their human and capital cost. For much of their work, people in those firms can operate a lot more easily, comfortably, and produc-

tively from satellite offices around the city's periphery.

Commuting time can fall from half an hour or more each way—sometimes, much more—to a few minutes. First-class suburban space may cost half as much as downtown space. In a suburban office, the workday is no longer defined by employees' willingness to outsmart or endure traffic-flow patterns morning and night, and no longer begins and ends with enervating rides in sluggish traffic or with shoving matches in subway stations.

SATELLITE OFFICE NETWORKS

Many of these "knowledge workers" already rely on PCs, of course, but the real keys to the spread of networks of satellite offices are the coming advances in tools to interconnect those desktop machines from office to office and to tie them to larger computers, probably (but this is immaterial) in a central office that remains downtown.

As workers learn that they can reach colleagues in other satellite offices as easily by computer as they once did by walking down the hall—and can exchange documents, budgets, schedules, and plans through high-speed modems while discussing revisions on a second telephone line—they fall hard for the idea of suburban offices.

This scenario is a giant step beyond the obsolete, limited vision of clerical "telecommuters" handling repetitive data-entry from their dining tables. As with other innovations, the idea didn't have much appeal to management until more-valuable



■ JIM SEYMOUR

processes were involved. Also, employees in work-group satellite office environments avoid the loneliness of the solitary home worker and the distractions of household routine.

Certainly many firms will find they still need some presence in the central city for occasional meetings with their clients who are based downtown, for staff meetings, and perhaps for the (declining) status of

having a "downtown location."

But rather than 40,000 feet on two floors, that office can become 2,500 feet of space that includes a reception area, a couple of conference rooms, and a few modest shared offices to be used by whoever in the firm is in the central office that day.

Many central-city developers are finding prospective tenants less interested in their new "smart buildings" than they'd expected. In part, that's because prospective tenants have begun to recognize the limitations of the expensive, centralized megaoffice—no matter how much coaxial cabling has been installed.

This change is neither trendy nor transient, but represents a fundamental restructuring of the office-space market. And, as in so many watersheds of social change, it's ripe with new business opportunities for the agile.

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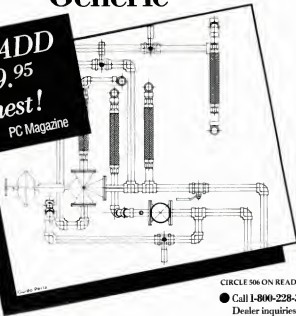
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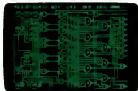


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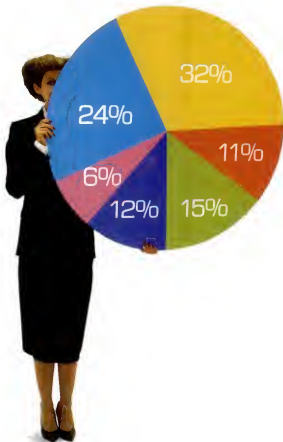


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Color Graphics Board	99



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Enhanced Graphics	
Adapter (EGA)	239



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Monochrome Board	109
PARADISE SYSTEMS	
Auto Switch EGA Card	359

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QUADRAM	
EGA Plus Graphics	369
SIGMA	
EGA Board	369
Color 400 (Princeton)	479
STB	
Chauffeur	209
309	
TECMAR	
Graphics Master	399

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5251-11	629
DCA	
IRMA Board	779

MODEMS

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Reach 1200 Half Card	\$299
EVEREX	
Evercom II	149
HAYES	
Smartmodem 1200	389
Smartmodem 1200B	
w/Smartcom II	359



Smartmodem 2400	599
Smartmodem 2400B	
w/Smartcom II	549

LOGICWARE

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Baud External Modem	199
Logic (Hayes Comp.) 2400	
Baud External Modem	309



Logic (Hayes Comp.) 1200B	
Internal Modem with	
Mirror (Crosstalk Clone)	
Software	149
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Quadmodem Series	
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VEN-TEL	
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1200 Plus	329
PC Modem 2400 Half Card	469

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MICROSOFT	
Microsoft Mouse (Serial)	135
Microsoft Mouse (Buss)	125

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CURTIS	
Diamond	39
Emerald	45
Ruby	59

KEYBOARDS

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5151 (Deuxe)	\$169
5153 (w/touch Pad)	279
3270 PC	235
5151 (AT&T)	189
Keytronic Jr. 5151	169

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Bernoulli Box (20 + 20)	2750
Bernoulli Box Plus	4199

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60 Mb Internal Hard Drive	
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Excel Stream 80 Mb Ext	929

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Irwin 110 10 Mb Int	499
20 Mb Int	599
20 MB 325 (AT) Ext. D.	779

LOGICWARE



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Cartridge Tape Backup	
Kit	729
Logic 20 Mb Internal	
Cartridge Tape Backup	
Kit	569

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20 Mb Int	599
Image Tape Backup	
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TECMAR

QIC 60 AT	1239
QIC 60 Ext Tape Backup	1579

CORE

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-----------	------

FLOPPY DISK DRIVES

Panasonic 360 K 1/2 HL	\$119
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PC Magazine calls Sysgen's Smart QIC-FILE their "hands-down choice for the best of the units tested."

And PC Magazine says, "The Sysgen Smart Image is an ideal choice" for backing up your XT.



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SMART QIC-FILE 60MByte cartridge tape protection. \$1395 internal, \$1495 external.



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Both systems include Sysgen's Smart Software. And both come with the high quality, reliability and technical support that have helped make Sysgen #1 in tape back-up systems.

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You won't believe how easy it is to use Sysgen's automatic tape back-up. Set your Smart QIC-FILE or Smart Image once, like a VCR, and it will back up your hard disk automatically, once or twice a day, seven days a week. If you're using your system, it will wait till you're through, then back up the files you select. *That's smart!* And painless.

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■ STEPHEN MANES

THE PERMANENT INTERIM



When does technological progress cause industry inertia? When IBM keeps its plans to use hot new technologies like the 80386 chip a secret, that's when.

Remember the hot gossip toward the end of 1984 about the imminent IBM PC II? The machine with a 186 microprocessor (maybe even a 286!), a footprint smaller than Twigg's, a gnatsize price tag, and a knockout punch for clonesters? Potential buyers spent so much energy making guesses about this sexy new creature of fantasy that they stopped courting the homely old PC. To resurrect sales and restore order, IBM had to step in and officially squelch the rumors.

A similar flurry of speculation accompanied the impending arrival of the PC Convertible. It would be a quantum leap forward. The IRS would buy zillions. A whole new market would be born. Then—surprise!—the IRS knighted Zenith, and the actual PC Convertible turned out to be more of a Studebaker than a Mercedes. It has since been generally accepted that better returns on speculation are available from three-card monte.

AGE OF INFORMATION? Lately we seem to have entered yet another period of eager anticipation, but that's not the half of it. In truth, the microcomputer business has entered "The Permanent Interim." Everything keeps happening so fast that something better is always just around the corner. At any given moment it seems to make sense just to sit tight and see what develops.

It's a weird paradox: unprecedented activity produces unprecedented stasis. Even more paradoxically in this supposed Age of Information is that The Permanent Interim is the direct result of a lack of informa-

tion. The main reason you can't make plans is that computer corporations—one taciturn behemoth in particular—won't divulge theirs.

32 BITS The next generation of machines, the 32-bit 386-based speed demons, is just over the horizon. All the power users I know are positively slaving over the prospect. But the first crop of 32-bit fledglings is virtually certain to be born long before IBM hatches its 386-based plans. Until there's an operating system that can make the 386 perform all the multitasking tricks it was born for—with current DOS applications, no less—early 386 machines will be little more than supercharged ATs. Nice, but hardly anything to drool over.

You can bet IBM will offer a multitasking operating system on its 32-bit machines when they finally arrive. But only God and IBM Chairman John Akers know

whether it'll be an IBM-only proprietary DOS or an "open" (that is, Microsoft) model. Neither deity is talking.

So the customer faces a real quandary. An early-model, non-IBM 386 machine can hardly be expected to conform to unavailable future IBM standards. Worse, the AT may well remain doomed to its current role as a high-speed XT. Because the 286 lacks many of the 386's hardware filips, a 286-based, protected-mode DOS may well turn out to be far less acceptable than any 386 version. The potential 386 buyer and AT buyer therefore decide to rein in their enthusiasm until IBM drops one of its hobnailed boots. The result: a nice, long interim where everybody's waiting and nobody's buying.

Less publicized, less important, yet equally symptomatic of The Permanent Interim is the war about to erupt between rival graphics coprocessors from Intel and Texas Instruments. Both can make an EGA look like the bad joke it is. Neither will become part of a widely embraced standard until IBM comes out with an official benediction.

PRICE AND PRIDE In poorer sections of the community, the ongoing drama is the decline and fall of prices. If you really want to low-ball, right now you can purchase a PC-DOS system complete with monitor and printer for under \$1,000. If you wait, it may become even cheaper—almost a throwaway.

Maybe that's exactly what it is. All of a sudden, good old dependable DOS is being spoken of in the snide tones reserved



NOW. POWERFUL WITHOUT POWER



A typical DBMS user's screen, after the 497th line of code.

SELECT ALL FROM carport SORTED BY carplate WHEN:

--Choose an operator to combine conditions-- Choose (Enter when done)

AND OR AND NOT OR NOT (Done)

Column	Operator	Value
OR	district	50
AND	carplate	50
AND	comment	contains
		March 12 1985
		American Savings Company

An R:BASE System V Prompt-By-Example (PBE) screen. With PBE's query capabilities, you can retrieve just the information you need. Without programming.

Aunt Betty's Baked Beans

Transaction date: 6/75/86 Date: 6/75/86

Transaction number: 4000

Customer number: 000

Name: Speedy Shipper Inc.

Address: 400 Industrial Way

City/State/Zip: Dayton, New York 13055

Phone: 800 555 0661

Stock #	Brand	Qty	Price	Extended Price
207	Bacon & Bean Cakes	95	2.00	189.50
506	Peas & Butter Cakes	100	2.50	250.00
679	Boulder Rich Beans	150	4.95	742.50

A data entry screen designed without programming, using Forms EXPRESS.

With most database management software for the IBM PC family and compatibles, you're quickly confronted with a painful reality: the only way to make your package live up to its promise is to learn its programming language. Which can take months. Then you have to write the code, line after frustrating line.

But now, there's R:BASE™ System V. And for the first time, you can quickly create programs that automate your most important data management tasks. Without programming.

Of course, with R:BASE System V, you can enter, query, and report on data in a non-automated, ad hoc fashion. Without programming. And there's a high-level procedural language for programmers. But that's just the beginning.

R:BASE SYSTEM V. IT GIVES NON-PROGRAMMERS POWERFUL PROGRAMS.

With the EXPRESS System in R:BASE System V, you can access powerful features, without programming, that other data management software can't touch.

With Definition EXPRESS,

you can build a database structure with advanced features like computed columns, and searchable note fields. VIEWS that combine up to five tables in a single, powerful table. Data validation rules that check incoming data for errors. All without programming.

Then you can use Forms EXPRESS to create customized data entry forms. The forms you create can load data into five different tables, linked in One-To-Many relationships. You can also include scrolling regions, custom borders, and custom colors, all without programming.

And with Reports EXPRESS, you can design reports exactly the way you want. And see what they'll look like, right on the screen. To see how complex your reports can be, take a close look at the example at the end of this page.

Finally, you can tie it all together with Application EXPRESS. First, you design your own multi-level system of menus. Your first menu level might look like this:

Aunt Betty's Sales Reporting System

- (1) Enter Sales Data
- (2) Edit Sales Data
- (3) Print Daily Sales Report
- (4) File Processing
- (5) Exit

For each menu choice, you assign an action. For example, to define

menu choice #3, choose the action "PRINT," select the report you just created in Reports EXPRESS, and specify the appropriate data sorting and selection criteria. Then Application EXPRESS automatically writes the program code.

Which means you've just created a very sophisticated program to deliver the full power of your DBMS. And you've done it all without learning how to program. From this point on, every time you want to run a report, all you do is choose item #3. With one simple keystroke, you've got it.

R:BASE SYSTEM V. IT GIVES PROGRAMMERS A POWERFUL ENVIRONMENT.

If you're an experienced programmer, you can use R:BASE System V to tackle the most demanding applications. You can use Application EXPRESS to create prototypes faster than with any other microcomputer-based DBMS.

There's a high-level procedural language, and a full set of relational operators that can leverage up to 80 tables, all of which can be open at once. While you're racing along, a data dictionary

DBMS PROGRAMS R:FUL DBMS PAIN.

keeps track of the action.
Automatically.

For demanding analyses, there's a set of 70 math, statistical, financial, scientific, and string manipulation functions. You also get more capacity for your data. Comprehensive menu-driven import/export capabilities. Superior relational power. And much, much more.

THE MOST POWERFUL DBMS FOR ONE USER OR A WHOLE NETWORK— ALL IN ONE PACKAGE.

In addition to its standalone personal computing power, R:BASE System V has all the features you need to share data on a local area network (LAN) built right in. When you're ready to network—now or later—this is the only DBMS package you'll ever need. And no matter how many users you add, you'll never have any growing pains. Because an unlimited number of users, attached to a LAN, can access R:BASE System V.

SEE FOR YOURSELF: \$15.95.

We're confident you'll find R:BASE System V the shortest distance to your data management solution. Visit your computer dealer for a trial run. Or, if you prefer, we'll send you a Trial Pack

15 line header (up to 65 lines possible)

Four levels of grouping (up to 10 levels possible)

Time and date stamping

Supports issues and other special printer commands

Draws summary line for grouping

Draws bases anywhere in report

Aunt Betty's Baked Goods, Incorporated California Division Daily Sales Report For June 25, 1986 Confidential Information		TOTAL SALES
Page: 1	Tuesday, June 24, 1986	
Date:	Time: 8:00 am	
1 Of 1986	2 Southern California	
3 Cracker Products	4 Wheat Crops	
	Rye Crackers	
Total Cracker Product Sales		97,536.22
Sweet Goods Products	Bake-A-Bunch Cookies	235,223.11
	Peanut Butter Crunch	332,759.33
	Cocoanut Macaroons	25,009.23
	Double Rich Brownies	8,623.30
Total Sweet Goods Product Sales		19,440.40
Total Sales, Southern California		113,636.01
		166,712.44
		499,471.77
Northern California		
Cracker Products	Wheat Crops	
	Rye Crackers	
Total Cracker Product Sales		57,406.25
Sweet Goods Products	Bake-A-Bunch Cookies	175,223.56
	Peanut Butter Crunch	232,629.81
	Cocoanut Macaroons	45,146.55
	Double Rich Brownies	47,123.80
Total Sweet Goods Product Sales		9,300.99
Total Sales, Northern California		517,446.25
		619,107.59
Total Sales		851,737.40
		1,351,209.17

for only \$15.95, plus shipping. It's a fully functional, row-limited version of R:BASE System V. Just call 1-800-547-4000, Dept. 975 In Oregon or outside the U.S., call 1-503-684-3000, Dept. 975.

What if you already own R:BASE 5000? If you bought your copy before June 30, 1986, you can trade it for the full power of R:BASE System V. For only \$99. (Offer expires January 31, 1987.) Just give us a call at 1-800-248-2001. Outside the U.S., call 1-206-885-2000.

A program to print this report daily, with a one-stroke menu pick, was developed without programming using R:BASE System V's EXPRESS Technology. Whether you know how to program or not, R:BASE System V is the shortest distance to your data management solution.

NEW R:BASE SYSTEM V FROM MICRORIM



■ STEPHEN MANES

for a moribund product. Rumors are flying that *Microsoft Windows* will largely become the DOS user interface of the future. But *Windows* on 8088 machines runs like a chocolate turtle (a fact Microsoft more or

less admits with its *Windows*-engine accelerator boards) and not at all on monochrome cards. Denied access to the slow, big, easier-to-use programs that will eventually become standard on 386 machines,

8088 boxes could become what 8-bit CP/M computers are today: not obsolete, exactly—just crippled.

Price isn't solely a low-end consideration. IBM will undoubtedly ask top dollar for its hot new machine. It'll get it, too, until clone makers come up with compatible models—if, given a proprietary operating system, they actually can.

So the price mystery adds its own form of inertia to The Permanent Interim. If you know IBM's 386 machines will cost \$10,000 for the foreseeable future, you may just say the hell with 'em and go out and buy half-a-dozen AT clones instead. But if a 386 machine will cost \$50 more than today's AT, you'd have to be a fool not to wait. For now, you can't be blamed for sitting on your wallet.

CORPORATE SECRETS The main cause of The Permanent Interim is lack of information, and the main cause of that lack is corporate secrecy. Sure, some heavy hitters get to see new stuff under nondisclosure agreements, and some of the information leaks out. But by and large, IBM keeps secrets at least as well as our armed services—to the detriment of the microcomputer business and industry in general.

IBM uses its announcement policy as a tactical weapon—a preemptive strike here, a late but powerful barrage there. Now and then, as with its networking announcements, it hints selectively at future plans. Most of the time it's "no comment."

What we don't know can't hurt our friends at IBM—they figure you'll pay them now or pay them later. But it can and does hurt the rest of us. Software development stalls while developers wait for IBM to get its act together. Buyers fidget while they await the forthcoming model. Everybody keeps looking over his shoulder for The Beast in Blue.

Has any other industry ever worked this way? True, car manufacturers got away with planned obsolescence for years—until Japan and the Middle East helped customers wise up. But The Permanent Interim seems different. It appears to be part of the juggernaut called technology. There's nothing planned about it.

Or am I being absurdly naive? ☐

Advertisement



REVIEWS IN BRIEF

Turbo-Cool: Keeping Your PC from Overboiling

BY JIM FORNEY

After years of slaving over hot circuitry, my faithful, overloaded IBM PC is running at least 15 degrees cooler these days thanks to an add-on cooling fan called Turbo-Cool from PC Cooling Systems. Turbo-Cool (formerly known as "Silencer, model HP") bolts onto the back of the PC over the power supply's exhaust grill, drawing up to 100 percent more air through the unit.

Prior to installing the Turbo-Cool, I measured a 30-degree temperature rise above ambient room temperature with a temperature probe positioned just above the motherboard and tucked in between two expansion boards. With Turbo-Cool installed and the temperature probe in the same location, the temperature rise was cut exactly in half—a mere 15 degrees hotter than my room—and the top of the PC's cabinet was significantly cooler to the touch at the hottest point (just above the location of the probe). Although "Silencer"—the name under which it was originally marketed—was a misnomer, Turbo-Cool's fan is much quieter than IBM's built-in cooling fan. In fact, there is no significant increase in the noise level with Turbo-Cool running.

Installation couldn't be easier, as it doesn't require going inside your computer at all. To install Turbo-Cool on a PC or XT, all you have to do is remove four screws from the back panel that secure the power supply in place. Then you simply attach the fan unit by inserting the longer screws supplied with it back into the same holes. The Turbo-Cool unit is just 3 inches thick and adds that much to the depth of a PC

when installed, but in terms of required clearance behind the CPU, it doesn't add much beyond what you would normally leave to prevent kinking all those connecting cables anyway.

The fan is supplied with a "Y" power cable, one end of which plugs into the monitor outlet on the back of the computer so that Turbo-Cool turns on automatically when you start your system. The other end of the Y has a monitor receptacle similar to the one that the fan has taken, so none of the original functionality is lost.

I've overheated my computer more than once, especially in hot weather. Heat can be a major problem and can cause all manner of strange things to happen, as well as shortening the lifespan of all those expensive plug-in boards and gizmos you've added to your system. This looks like it's about as slick a way to keep the bugs away on a hot night as any I've seen. ■



Turbo-Cool
PC Cooling Systems
Bonsall, CA 92003-0518
(619) 723-9513
Price: \$69.95 (PC or XT)
\$79.95 (AT)
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Complete Systems

Each Hard DiskCard comes complete with everything you need, installs in minutes, boots off the hard disk, has a programmable interleave factor of up to 1-to-1,*** and has plated media. You can add it to an existing hard disk and, for an extra \$95, have both disks act as one.

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Express Hard DiskCards give you from 20 to 60 megabytes of rigid disk storage, and something more. The controller comes with a programmable interleave factor of up to 1-to-1, which means that you retrieve data up to 6 times faster than the PC XT which has a 6-to-1 interleave controller.

Access Speed

The Express Hard DiskCards, with an average access speed of 60 msec, gives you—in addition to that extra speed—head retraction. Before you start thinking you've just got to have head retraction, you should

know that the 80 msec Express Hard DiskCards are rated at 50 g's power off and 10 g's power on. Furthermore, our 80 msec Hard DiskCards, like all Express Hard DiskCards, have plated media. Most hard disks-on-a-card have iron oxide (it looks and acts like rust), which means if the head hits the iron oxide, it will gouge out media and your data along with it. Plated media, on the other hand, looks like a car's chrome bumper. If the head hits, it will cause little or no damage. That's why Express offers drives with high g tolerances.

All of the benefits of our 80 msec drives aside, you may want to get our 60 msec drive just for the extra speed. But in addition to increased

access speed, you'll be getting automatic head retraction.

50 percent faster

Our 30 and 60 megabyte Hard DiskCards give you more storage space, but in addition, they also give you a transfer rate of 7.5 megabits per second—a full 50 percent faster than an IBM XT or AT hard disk. Faster speed is important, and becomes more so if you want to combine disks.

One File, Two Disks

With Express Systems' new Conlesee™ Software, you can add our 20 or 30 megabyte Hard DiskCard™ to your existing hard disk. They will both work together as though they were one disk—up to 144 megabytes worth.

Conlesee not only merges the two hard disks together, it bypasses the DOS barrier of 32 megabytes. That means that if you already own a 114 megabyte hard disk, you can add our 30 megabyte Hard DiskCard and have a total of 144 megabytes as a single file!

However, if you don't have a

Features	20AT**	2080	Models				4080	6060
			2060	3080	3060	4000MB		
Capacity formatted	20.05MB	20.00MB	20.05MB	30MB	30.08MB	40.00MB	60.16MB	
Transfer rate	5Mbits/sec*	5Mbits/sec	5Mbits/sec	7.5Mbits/sec	7.5Mbits/sec	5Mbits/sec	7.5Mbits/sec	
Avg. access time	60msec	80msec	60msec	80msec	60msec	80msec	60msec	
Slots	1½	1½	1½	1½	1½	2	2	
Media	Plated	Plated	Plated	Plated	Plated	Plated	Plated	
Warranty	1 year	90 days	1 year	1½ years	2 years	2 years	2 years	
Head lifter	automatic	manual	automatic	manual	automatic	manual	automatic	
Price	\$449	\$495	\$595	\$695	\$795	\$995	\$1,095	



Discover why companies like AT&T, IBM, Bell Labs, Polaroid, Kodak, 3M, JC Penney, Sperry, Hughes Aircraft, Stanford University, Allied Corp, the Associated Press and others have bought Express Hard DiskCards.[™]

hard disk now and want 40 or 60 megabytes of hard disk storage, then our Express Double DiskCard[™] comes with two hard disks. You can use one disk to back up the other with our automatic backup software *Auto DiskSave[™]* or for an extra \$95, you can buy Coalesce and have both disks work as one.

Free backup program

All Express Hard DiskCards are available with a free backup program, *DS Backup[™]*. This easy and convenient program—a \$69.95 value—makes backing up simple and fast. And to receive it, all you have to do is ask for it when you order.

AT Backup DiskCard[™]

How would you like to know that your IBM AT's hard disk is always backed up without having to think about it. With Express Systems' AT Backup DiskCard[™] you can have 20 megabytes of hard disk backup on a card without taking up valuable front panel space. The AT Backup DiskCard comes with *Auto DiskSave* software, so you



Complete Hard Disk Kits—(all transfer rates 5 Mbits/sec)

Formatted Storage Capacity in Mbytes	Height	Plated Media	Average Access	Comments	PC or PC/XT	AT
10	1/2	no	85 msec	Low power	\$ 295	N/A
21	1/2	yes	85 msec	Low power	Call	Call
32	Full	no	30 msec	CDC WREN II drive	\$1,295	\$1,195
72	Full	no	25 msec	Ideal AT drive for LAN	\$1,795	\$1,695
144	Full	no	30 msec	2 72MB drives as one volume	†	\$3,395

Removable Hard Disk

10	1/2	yes	90 msec	5 Mbits/s	\$1,095	\$1,095
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■ STEWART ALSOP

IS DESKTOP PUBLISHING FIT TO PRINT?



PC-based desktop publishing may become a reality someday, but on the current crop of low-cost laser printers, it's a bad joke.

What if . . . Hewlett-Packard stopped pretending that the LaserJet Plus is designed for desktop publishing?

Warning: If you happen to have a Hewlett-Packard LaserJet Plus or any one of that ilk of low-cost laser printers, don't go near a Macintosh connected to an Apple LaserWriter. You'll be corrupted forever.

I'm not just saying that because the \$6,000 LaserWriter is a swift piece of hardware, which it is. I'm saying that because the industry is in the process of foisting a giant fraud on PC users that goes by the name of desktop publishing. However good the next generation of DOS desktop publishing software is (they'll be evaluated in detail in *PC Magazine* in December), desktop publishing with a LaserJet Plus printer is a travesty for any but the most technically sophisticated and motivated users.

Hewlett-Packard introduced its original LaserJet printer in 1984 as a high-quality, fast, quiet (and expensive) replacement for daisy wheel printers. The thing cost about \$3,000 at street prices, but it produced marvelous-looking letters and was easy to share among users on a network. It also sold like crazy: something more than 150,000 in the last 2 years, giving HP about an 80 percent share of the laser printer market.

Then Apple Computer entered the market early in 1985 with its LaserWriter printer with built-in type fonts, a page-description language called Postscript, and a hefty \$7,000 price tag. Apple also sold a lot of LaserWriters, more than 30,000 at

last count. More important, the LaserWriter combined with a Macintosh and a program called *Pagemaker* created a new application for personal computers: desktop publishing.

Now the industry is abuzz about desktop publishing. Software developers have more than two dozen page composition programs in the works or on the market; word processing developers all claim that their products "do desktop publishing"; and printer manufacturers are going nuts trying to rush new laser printers onto the market.

TYPESET OR PRINTED? The essence of the desktop publishing fraud is expressed in these new printers. The basic promise of laser printers is that they can produce printed material that looks typeset to the untrained eye. Whether you're printing a basic business letter, a simple 12-page newsletter, or a 200-page book, a la-

ser printer can make a document look like you spent a lot more money producing it than you actually did.

The term *desktop publishing* implies that you can produce a document that, at a minimum, contains mixed type styles in mixed sizes (say, Times Roman light, bold, and italic in 10 or 12 point and Helvetica bold in 24 or 30 point), lines and boxes, and perhaps a simple bar chart or graphic design. On a Macintosh and LaserWriter, text fonts and graphics are built into the system files. So you merely format the document on-screen, pull down the file menu, and print. Should you want to use a font that isn't in the standard system file, the computer will search your disk for the font and download it automatically to the printer. If the computer can't find the right font, it will make an educated guess and substitute another.

However, coaxing a LaserJet-class printer (which includes any printer that's priced between \$2,000 and \$4,500, covering everything from the QMS KISS to the AST TurboLaser) to produce such a document is not as simple as the industry would have you believe.

WASTING TIME On a PC with a LaserJet, the ability to format a document on-screen and match it to your printed output will depend on how much planning you've done for your document and how capable the composition program is. With a LaserJet Plus (mainly distinguished from the original LaserJet by having enough additional RAM to allow you to download fonts), the appropriate fonts must be



■ STEWART ALSOP

downloaded before you attempt to print your document, which means that you must quit the composition or word processing program, use a utility program to download the font files to the printer, and

return to the main application (a process that will take about 25 minutes). If you decide you want to use a different font, you must repeat the process. Even then, you still must have a monitor with enough reso-

lution to accurately display what you will get, or face wasting time experimenting with printouts.

GREAT FOR LETTERS Don't get me wrong. The LaserJet is a wonderful device for producing business correspondence. If all you want to do is print beautiful letters, memorandums, or reports in one basic type style with no graphic elements, a basic LaserJet with the right cartridge is right on target: fast, quiet, flexible. But the LaserJet, even one with more memory, was never designed for the kind of page composition tasks that have come to be associated with the term *desktop publishing*.

■ Manufacturers have done a miserable job of learning why users buy laser printers. What users are screaming for is a product that is more capable.

Worse, the printer manufacturers that want to compete with Hewlett-Packard have done a miserable job of learning why users buy laser printers. The printer makers are putting out products that work faster ("Our printer can do 12 pages per minute!") or longer ("Our printer has a duty cycle of 20,000 pages per month!") or cheaper ("Our printer only costs \$1,995!"). But what users are screaming for is a product that is more capable, has more built-in fonts, and is supported by more-capable applications software.

Over the next 6 months, ads, books, and magazine articles will extol the virtues of desktop publishing with the LaserJet Plus, but they probably won't tell you that you have to become an expert typesetter in order to do what they say you can. It's nearly criminal to lead people into the kind of frustration they will inevitably experience as a result of this fraud.

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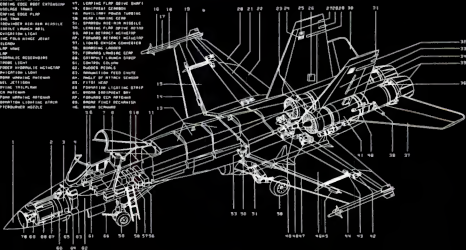
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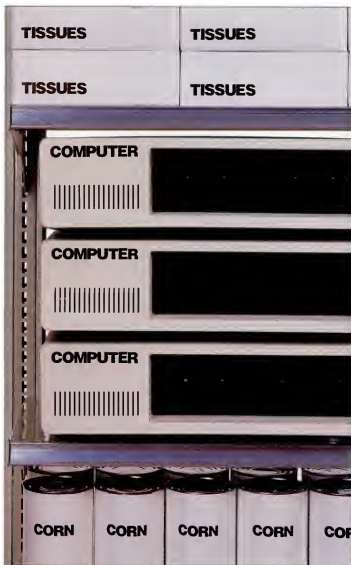
PAUL M. STAFFORD

The Cheapest PCs Ever

Should IBM be worried that PCs have indeed become a "commodity"? Many low-cost compatibles have flooded the low end of the market, but performance and the quality of design and construction do not, in many cases, measure up to the high standards set by IBM.

Prices on IBM PC- and XT-compatible personal computers are dropping fast, and the bottom is nowhere in sight. The original IBM PC, with 48K bytes of RAM and no monitor, sold for \$2,235; with the most recent price cuts, this model, with one disk drive and 256K bytes of memory, lists for \$1,445 and can be had for about 30 percent less on the street. So when *PC Magazine* discovered a wealth of compatibles with price tags under \$1,000—which in some cases even included a monitor and hard disk—the staff in PC Magazine Labs could no longer resist the temptation to find out just what buyers would get for their money.

Low-cost compatibles make no advances in technology—no AT speed, no EGA color, no expanded RAM—in fact, they offer nothing that hasn't been available for a long time. Their single distinguishing feature is price. Even their names are prosaic: four of



the machines are called "Turbo XT," and one of them is simply labeled the "PC Clone." However, where PCs are concerned, "low cost" still means a fairly significant outlay. A computer that costs \$1,000 and breaks the next day or does not meet your performance needs is a waste of \$1,000.

THE ASSEMBLED PC In "Cost-Conscious Computing" (*PC Magazine*, Volume 4 Number 21), the machines reviewed were fully PC compatible and cost less than \$2,000. At the time, six machines met these criteria. Less than a year later, with the maximum price cut in half, the Labs staff tested three times as many machines. It doesn't take a mathematician to understand the equation: as the prices for PC compatibles approach rock bottom, every day more and more vendors are trying to get in on the act.

How can so many mail-order houses offer their own inexpensive versions of the pride of IBM? They buy their components the same way they sell them: through mail order. The components that make up a low-cost PC compatible are as easy to find as the distributors' advertisements in the nearest computer-dealer trade magazine. The latest issue of one of the biggest dealer weeklies revealed some incredible prices for the guts of a pretty powerful computer system. For example, an XT-style motherboard slotted for 640K bytes of RAM (with 0K bytes on board) goes for \$99 in single quantities. That includes a "compatible, noninfringing BIOS." A laptop case runs about \$30; add \$75 for a 150-watt power supply, \$55 to \$65 for a keyboard (depending on whether you want PC- or AT-style), about \$120 for a 360K-byte floppy disk drive and controller, and you're in business. The RAM chips add an

■ THE CHEAPEST PCs EVER



Kamerman Labs XT



Adtek Turbo XT



ITS Turbo XT



DLXT Turbo 640



Advanced XT/PC



Apparat Turbo PC



Computer Mail Order PC Clone



PC Designs XT



Baby Micro XT

All of the "cheap PCs" tested look virtually the same, with only the most minor variations on the IBM theme. The minimal, visual differences among them include drive configuration, monitor type, and such features as status lights. AT-style keyholes, keyboard layout, and, of course, the logos. The actual configuration and quality of components vary from manufacturer to



ANI PC-2



American Micro AT Jr.



Wisetek Turbo XT



THE PC+



STD Turbo 86



PC's Limited Turbo XT



Victor VPC II



WIN Labs XT Compatible



Micro 1 XT Turbo

manufacturer. One company's base price may include a hard disk while another's doesn't even include the monitor, so "cheap" is sometimes deceptive. And when it comes to performance, 12 of the 18 pictured here operate in both standard and turbo modes, which means that they dramatically outperform the IBM PC-XT (see the accompanying benchmark-test results).

THE FIRST PC

The original 1981 PC cost a bundle for a lot less machine.

Reading a price list for IBM's first PC is like listening to Grandpa describe his Model T, but only if the Model T had been priced like a Maserati. Has it really been only 5 years since that day in August 1981 when the first PC was introduced to the marketplace?

The first true PC, complete with 48K bytes of RAM and one 160K-byte floppy disk drive, sold for \$2,235. There were plenty of options to improve the machine's performance, of course. A monochrome monitor for \$345 was an essential accessory, as was a second disk drive for \$570. Those items purchased today may set you back \$89 and \$85, respectively.

If 48K bytes wasn't enough memory, 64K-byte expansion cards were available for \$540 each. Today you can probably find nine-packs of 256K-byte cards, over

2,300K in all, for \$80. The mathematics: from \$8.43 to \$3.35 per kilobyte.

A display and printer adapter card, about \$150 today, cost \$335 way back then, bringing the grand total for a fully equipped PC that couldn't come close to one of today's IBMs in performance to something approaching \$8,300 (assuming it would be possible to expand memory in that machine to 640K).

By the way, that original \$2,235 PC now comes equipped with 256K RAM and a 360K disk drive. It can be yours for \$1,445, but keep an eye on the price; it may come down again. The recent entry of Tandon Corp. into the cheap-PC wars and the ever-growing market presence of numerous PC clones has forced IBM to rethink its competitive strategy at the low end of the PC market.

—Don Willmott

insignificant amount to the total cost ("We buy 'em by the pound," one dealer joked), so for a parts bill of less than \$400—and that's based on single quantities—a dealer can put together the basics of a 640K PC system.

PC Labs' results confirm that the low-cost compatibles are being assembled more than they are being manufactured. Out of the 19 machines tested, 4 (the Information and Technology Systems (ITS), PC's Limited, Apparatus, and Northeastern Software units) had the same motherboard—something called the XTurbo Board. Most of the motherboards carried the "Made in Taiwan" legend, and three—the WIN Labs XT Compatible, the DLXT Turbo 640, and the Baby Micro XT—had ROM BIOSs dated October 16, 1984 (a very good vintage for BIOSs, no doubt).

The bottom line is that anybody with a few dollars in capital, a mailing address, and a garage can put together a machine, sell it for less than \$1,000, and still make a substantial margin. In fact, the cost of a system built around one of these low-cost

motherboards is liable to be mostly made up of what you spend on peripherals: monitor, disk drives, and other exotica.

ON THE JOB (MARKET) A somewhat smaller source of cheap PCs is the so-called "job-lot" market, where products that are no longer being actively marketed but remain in inventory find their way into the hands of dealers who sell on the basis of price alone and care not a whit for having the latest, greatest, or best-supported equipment. And with the IBM standard so deeply embedded in the market, these discontinued machines are not a bad bargain at all, if they were made by reputable manufacturers in the first place.

One example of a decent job-lot machine is Advanced Computer Products' Advanced XT/PC. Peel off the stick-on label and—surprise!—it's really a Xerox. It's also a fairly humorous lesson in the history of the PC marketplace. Not a bad machine at all, the Advanced XT/PC suffers from a quirky interior design: color/graphics is built in and works with the included monitor (also a Xerox); the three

expansion slots, instead of accepting cards placed vertically into the bus, are fitted so that you must slide them in horizontally. This design not only makes cards a difficult fit, but looks funny. You'd think a big, smart company like Xerox that should know better, would. Its mistakes, though, litter the same highway that other major

■ The bottom line is that anybody with a few dollars in capital, a mailing address, and a garage can put together a machine.

computer players have traveled in attempts to translate minicomputer or mainframe success into the PC market.

When you go to buy a low-cost compatible, you'll find that the machines differ in some important ways. The most noticeable difference is the standard equipment that the dealers include with them. It is just as cheap and easy to include a faster version of the Intel 8088 CPU that IBM uses (such as the 8088-1, 8088-2, or NEC V20) as it is to adhere to more-mundane PC standards. Twelve of the 18 units tested claim to be "turbo" machines, with clock speeds that you can switch between the standard 4.77 MHz and either 6.66, 7.33, 7.77, or 8 MHz.

When dealing with these bargains, though, remember that turbo is as turbo does: in some cases it is a state of mind and little else. The DLXT Turbo's manual claims that you can switch from normal to high speed using the keyboard; actually, you have to go inside the machine and set jumpers to make the change. Nonetheless, any turbo machine will outperform a standard IBM PC. (See accompanying benchmark test results.)

THE REAL COST What you'll pay in order to build a usable system from your base unit should also factor into your

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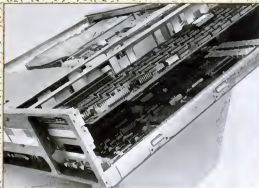
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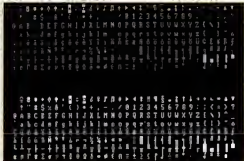
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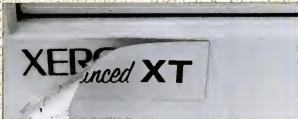
■ THE CHEAPEST PCs EVER



1



2



3



4



5

(1) Advanced Computer Products' Advanced XT/PC suffers from a quirky interior design. To install cards in any of its three expansion slots, you have to slide them in horizontally. Not only does this arrangement look funny, but it makes for a difficult fit.

(2) Some of the systems tested don't include monitors in the base price, and although the mail-order houses offer their own generic displays, these monitors are not always your best option. Screen quality is often poor. Like the Apparat Turbo PC, whose screen output is pictured above, many produce grainy text. You're better off springing for a higher-priced, name-brand display.

(3) Peel off the label and surprise! Advanced Computer Products'

Advanced XT/PC is a job-lot machine—actually a discontinued Xerox that found its way into the hands of a low-cost dealer.

(4) The best of the "cheap PCs" were characterized by boards that fit firmly and evenly into their slots, correctly aligned drives, and overall solid construction. Some units, like Data-Lite Systems' DLXT Turbo 640 pictured above, were so poorly made that it was impossible to fit standard PC cards into the slots.

(5) Many of the keyboards on the cheap PCs, like that of the Apparat Turbo PC pictured above (top) have nonstandard layouts and a mushy feel. The best one is the PC's Limited Turbo XT keyboard (bottom), although the ITS Turbo XT keyboard (middle) isn't bad.



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U.L. and C.S.A. Approved

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Coast Computer Accessories 6892 B Soquel Ave. Santa Cruz, CA 95062 (408) 479-0881 (800) 922-2587 (Calif. Only)	Detarep P.O. Box 5929 Orlando, FL 32655 (305) 843-5224 (800) 432-7042 (Florida Only)	Pers Systems of New York P.O. Box 388 Baltimore, New York 11710 (718) 657-1818	SAFE/COM Inc. 412 Linda Circle Baton Rouge, LA 70806 (504) 926-7186	KM Company 4255 LBJ Freeway Suite 282 Dallas, Texas 75244 (214) 458-0644 Houston (713) 920-2733
Currie Systems Inc. 3089 Leaman Ferry Rd. Huntsville, AL 35801 Local (205) 881-4223 Alabama (800) 334-6685 National (800) 633-2938	Acutek 4651 N. 1st Ave. Suite 107 Tucson, AZ 85718 (602) 628-9888	Compucraft 451 Post Road Holmes, PA 19043 (215) 532-6888	Network Micro Systems Inc. 23 Heatherton Way Thornhill Ontario, Canada L4J3E6 (416) 733-1730	All Computers International (International Distributors) FL Branch (305) 593-2121 TX Branch (817) 854-9033

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■ THE CHEAPEST PCs EVER

thinking. Most of the low-cost compatibles come with a single floppy drive and controller, a keyboard, and that's all, folks! Exceptions are the ITS Turbo XT, the Micro 1 XT Turbo, and the DLXT Turbo 640 (see "Low-Cost PC and XT Compatibles: Summary of Features" for exact configurations). By the time you add in a second floppy disk drive or hard disk and a display adapter and monitor, your computer generally will have cost you well over \$1,000, approaching \$2,000 if your storage needs are massive or your display requirements exotic.

The most important factor in your buying decision, though, should be the quality you're getting for your dollar. Most of the low-cost compatibles tested actually performed adequately; no engineering- or design-award winners here, but a few machines, like the Apparat Turbo PC (except for its keyboard), the ITS Turbo XT, the Victor VPC II, and the American Micro AT JR., earned the Labs staff's praise for their construction quality. On the other hand, some of the machines appeared to have little care invested in their construction, most notably the Computer Mail Order PC Clone, the DLXT Turbo 640, and the Baby Micro XT.

Opinions didn't vary widely among the Labs staff. The testers had similar reasons for liking the better units and for disliking the poorer ones. The best machines were characterized by motherboards that were firmly and evenly seated in their chassis, correctly aligned floppy drives, socketed chips, and slots that were easy to fit cards into and remove them from. The not-so-good units did not hold together well and had ill-fitting expansion slots, discolored motherboards, and other signs of shoddy construction.

One area where the testers expected to find problems, but didn't, was in the power supplies of the machines. In general, what they found were sturdy 135- to 150-watt units that could handle a fair amount of stress.

While quality of design and construction in each individual machine is undeniably important, perhaps even more significant is overall quality control at the factory. It works just like the automobile market: one guy buys a car that lasts 20 years, while the guy next door buys the

■ **The not-so-good units did not hold together well, had ill-fitting expansion slots, discolored motherboards, and other signs of shoddy construction.**

same car and has nothing but trouble with it. That a computer tests well in the PC Magazine Labs does not necessarily mean you will have no problems with it once it reaches your desk. An example here is the PC Designs XT (Plain Vanilla). The unit PC Designs sent us had problems reading the benchmark disk and frequently failed parity tests—a sure sign of impending disaster. When the tester complained to the company about the defective machine, a new one was sent immediately. It worked fine.

The moral is that, whenever possible, you should try before you buy. Make sure you have a money-back guarantee—like the ones offered with the Victor VPC II, the THE PC+, and the PC's Limited Turbo XT—before you invest good money in a potentially bad computer. A warranty on parts and service is certainly a must but not nearly as useful as a guarantee that lets you ask for your money back if what eventually arrives in the mail is not what you thought you ordered. And if you get a piece that is clearly faulty, don't hesitate to send it back.

An unconditional money-back guarantee is especially important in case you're buying from one of the smaller houses. Not only can quality control be a problem with these often fly-by-night establishments, but you have no assurance that the system you buy will be made up of exactly the same components as the one tested in PC Labs. Just as cheaper and more feature-laden PCs come along every minute, component prices are highly susceptible to

fluctuation, and there is nothing to prevent a mail-order company from switching to a less-expensive—and perhaps lower-quality—motherboard to expand its profit margins. On the other hand, a money-back guarantee won't do you much good if the company expires before your guarantee period does.

COMPATIBILITY Hardware and software incompatibility, while not nearly as much of a risk with today's look-alikes as with the semicompatibles of 2 years ago, is still something to look out for. Not one of the machines tested failed to run Lotus's

EDITOR'S CHOICE

The most important factors in buying a PC compatible are the same no matter where you buy or what you pay: quality, reliability, and performance. So the Editor's Choice among low-cost compatibles is the IBM PC. At \$1,445 the humble old PC costs a few extra dollars, but it is as solid as they come, has great documentation, and offers something none of the low-cost machines in this review can provide: peace of mind.

Of the machines tested, the best was the Victor VPC II from Victor Technologies. At a base price of \$1,095, the VPC II passed muster for this article only because it was a clear cut above the other machines tested in quality of construction and documentation. Nonetheless, by the time you build up a reasonable working configuration, you've spent nearly as much as you would for an IBM PC. If you're willing to risk the bankbook on a machine from a smaller outfit, the \$895 ITS Turbo XT from Information and Technology Services is our "best buy" recommendation. It lacks adequate documentation, as do the rest of the machines we tested, but it is well put together and includes two floppy disk drives and a monitor in the purchase price.

THE COST OF THE LOW COST COMPATIBLES

Before you buy a low-cost compatible, be sure you understand exactly what that low base price includes. The final cost of a complete system may be much higher.

Adtek Turbo XT

Adtek
3706 Realty Rd.
Dallas, TX 75244
(214) 241-5811
List Price: \$895 with one floppy disk drive, 640K RAM; second floppy disk drive, \$99; 20-Mbyte hard disk drive, \$389; monochrome monitor, \$99 to \$109; color monitor, \$349.

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Advanced XT/PC

Advanced Computer Products
1310 E. Edinger Ave.
Santa Ana, CA 92705
(714) 558-8813
List Price: \$895 with two floppy disk drives, 640K RAM; keyboard, \$123; color monitor, \$331; 10-Mbyte hard disk drive, \$457

CIRCLE 668 ON READER SERVICE CARD

American Micro AT JR.

American Micro Technology
1322 E. Edinger
Santa Ana, CA 92705
(714) 972-2945
List Price: \$699 with two floppy disk drives, 640K RAM; 20-Mbyte hard disk, \$469; monochrome monitor, \$169; color monitor, \$379 to \$439.

CIRCLE 664 ON READER SERVICE CARD

ANI PC-2

Alphanumeric Inc.
14060 Cunniff St., #1-103
Santa Fe Springs, CA 90670
(213) 921-8689
List Price: \$895 with two floppy disk drives, 640K RAM, monochrome monitor; 20-Mbyte hard disk drive, \$469; color monitor, \$295.

CIRCLE 648 ON READER SERVICE CARD

Apparat Turbo PC

Apparat Inc.
4401 S. Tamarac Pkwy.
Denver, CO 80237
(303) 741-1778
List Price: \$799 with one floppy disk drive, 640K RAM; second floppy disk drive, \$125; 20-Mbyte hard disk drive, \$399; monochrome monitor, \$180 to \$240; color monitor, \$399 to \$629.

CIRCLE 642 ON READER SERVICE CARD

Baby Micro XT

Baby Micro
13111 E. Briarwood, Ave., #250
Englewood, CO 80112
(303) 790-7717
List Price: \$695 with two floppy disk drives, 256K RAM, monochrome monitor; 20-Mbyte hard disk drive, \$425; color monitor, \$250 to \$320; 640K upgrade, \$60.

CIRCLE 664 ON READER SERVICE CARD

Computer Mail Order PC Clone

Computer Mail Order
477 E. 3rd St.
Williamsport, PA 17701
(800) 233-8950
List Price: \$799 with two floppy disk drives, 256K RAM; monochrome monitor, \$79; color monitor, \$289; one floppy disk drive and one 20-Mbyte hard disk drive configuration, \$1,099.

CIRCLE 648 ON READER SERVICE CARD

DLXT Turbo 640

Data-Lite Systems
1034 Rambling Rd.
Simi Valley, CA 93065
(805) 522-6465
List Price: \$1,059.95 with one floppy disk drive, one 20-Mbyte hard disk drive; second floppy disk drive, \$85; monochrome monitor, \$190; color monitor, \$375.

CIRCLE 668 ON READER SERVICE CARD

ITS Turbo XT

Information and Technology Systems
4600 Duke St., #303
Alexandria, VA 22304
(703) 370-7173
List Price: \$895 with two floppy disk drives, 640K RAM, monochrome monitor; 20-Mbyte hard disk drive, \$412; color monitor, \$300.

CIRCLE 647 ON READER SERVICE CARD

Kamerman Labs XT

Kamerman Labs
7861 S. W. Cirrus Dr.
Beaverton, OR 97005
(503) 626-6877
List Price: \$799 with one floppy disk drive, 640K RAM; second floppy drive, \$119; 1.2-Mbyte floppy drive, \$199; 21-Mbyte hard disk drive, \$599; monochrome monitor, \$129.

CIRCLE 667 ON READER SERVICE CARD

Micro 1 XT Turbo

Microsystems Group
2117 Stonington
Hoffman Estates, IL 60195
(312) 882-5666
List Price: \$995 with two floppy disk drives, 640K RAM, monochrome monitor; 21-Mbyte hard disk drive, \$435; color monitor, \$250.

CIRCLE 648 ON READER SERVICE CARD

PC Designs XT (Plain Vanilla)

PC Designs
5837 S. Barnett
Tulsa, OK 74146
(918) 252-5550
List Price: \$995 with two floppy disk drives, 640K RAM, monochrome monitor; 20-Mbyte hard disk drive, \$449; color monitor, \$325.

CIRCLE 660 ON READER SERVICE CARD

PC's Limited Turbo XT

PC's Limited
1611 Headway
Austin, TX 78754
(800) 426-5150
List Price: \$795 with one floppy disk drive, 640K RAM; second floppy disk drive, \$95; 20-Mbyte hard disk drive, \$449; monochrome monitor, \$159; color monitor, \$459.

CIRCLE 642 ON READER SERVICE CARD

STD Turbo 86

Standard Brands/CompuAdd Corp.
12303G Technology Blvd.
Austin, TX 78727
(512) 250-1489
List Price: \$629 with one floppy disk drive, 256K RAM; second floppy disk drive, \$99; 20-Mbyte hard disk drive, \$415; monochrome monitor, \$159; color monitor, \$459.

CIRCLE 649 ON READER SERVICE CARD

THE PC+

THE Computer Products with PC Network
319 W. Ontario St.
Chicago, IL 60610
(312) 280-0002
List Price: \$507 with one floppy disk drive, 640K RAM; second floppy disk drive, \$81; monochrome monitor \$79; 20-Mbyte hard disk drive, \$416.

CIRCLE 662 ON READER SERVICE CARD

Victor VPC II

Victor Technologies
380 El Pueblo Rd.
Scotts Valley, CA 95066
(800) 248-5252
List Price: \$1,095 with one floppy disk drive, 640K RAM; second floppy disk drive, \$200; monochrome monitor, \$199; color monitor, \$595; 20-Mbyte hard disk drive, \$800.

CIRCLE 661 ON READER SERVICE CARD

WIN Labs XT Compatible

WIN Laboratories
3805 Lake Blvd.
Annandale, VA 22003
(703) 280-2971
List Price: \$699 with one floppy disk drive, 640K RAM; second floppy disk drive, \$119; 20-Mbyte hard disk drive, \$440; monochrome monitor, \$119; color monitor, \$369.

CIRCLE 663 ON READER SERVICE CARD

Wisetek Turbo XT

Wisetek
469 Valley Way
Milpitas, CA 94105
(408) 263-1237
List Price: \$710 with two floppy disk drives, 640K RAM, monochrome monitor, color monitor, \$340; 20-Mbyte hard disk drive, \$445.

CIRCLE 644 ON READER SERVICE CARD

Five Tips On Buying A Personal Computer Through The

Buying by mail is one of the best ways there is to purchase computer equipment. It's fast, convenient and cost efficient. But with those benefits comes a risk... many of those inexpensive PC clones can turn into expensive headaches after arriving in the mail.

Before you order PC equipment from anyone through an ad, make sure it passes the following test. Taking a minute now could save you a lot of money... and a lot of aggravation.

1. Does the product come complete?

Many mail-order outfits leave out monitors, display cards, disk drive controllers and other essentials in an effort to keep the advertised price low. By the time you add in the cost of these components, you may not be getting such a "bargain" after all.

2. Is the machine fully tested?

Any computer is only as reliable as its components, so make sure it has passed a rigorous Quality Control test.



Don't be bashful; call the company and ask if the machine is built primarily with domestic hardware or inferior "offshore" parts. While you're at it, ask for reprints of any product reviews from respected publications like this one (if they can't provide any, don't take a chance—no matter how low the advertised price is).

3. How compatible is the BIOS?

Everyone claims some degree of "compatibility," yet frequently these same machines won't run some popular software packages. If a mail-order outfit can't tell you what BIOS their machines use, steer clear (The AMI BIOS is generally considered the most compatible).

4. Does the machine meet FCC specs?

Many price-cutting PCs don't meet FCC "Class B" home-use guidelines. That means they could interfere with your television, stereo and other appliances. Watch out for disclaimers in the ad, or PCs rated to less demanding "Class A commercial" FCC standards.

5. What is the company's reputation?

Sometimes you can tell a "fly-by-night" outfit just by looking at its hastily-prepared, slipshod ad. But even if their ad looks slick, keep up on the product reviews in magazines like this one. Or better yet, call the editors directly and ask them.

Four More Ways To Make Sure You're Getting The Best Value.



PC Designs has always passed the test above with flying colors. From the super high-performance ET-286i to the super high-value Platin Vanilla, our competitors are among the most respected on the market today. That's because we won't put our name on anything we don't design ourselves, from the best components available. And PC Designs support is legendary; we were the first to offer a 30-day money back guarantee and a full year warranty.

Any Questions?

We hope this ad will help you make a more informed buying decision. But if you have questions, we invite you to call us at our Tulsa headquarters. And while you're at it, ask for our literature.

PC Designs

5837 South Garnett
Tulsa, Oklahoma 74146
(918) 252-3350

CIRCLE 373 ON READER SERVICE CARD

■ THE CHEAPEST PCs EVER



Low-Cost PC and XT Compatibles: Summary of Features

(Listed in ascending order of price of configuration tested)

Product Manufacturer	Base price	Base price includes	Price of config. tested	Configuration tested	Options
Wisetek Turbo XT Wisetek	\$710.00	640K RAM, two floppy disk drives, floppy disk controller card, monitor	\$710.00	Two floppy disk drives, monochrome monitor	20-Mbyte hard disk, \$445; color monitor, \$340; color/graphics card, \$78
STD Turbo 86 Standard Brands/CompuAdd Corp.	\$629.00	256K RAM, one floppy disk drive, floppy disk controller card, multi I/O card*	\$788.00	One floppy disk drive, monochrome monitor	2nd floppy disk drive, \$99; 20-Mbyte Miniscrba hard disk, \$415; 30-Mbytes, \$499; monochrome monitor, \$150; color monitor, \$459
Baby Micro XT Baby Micro	\$695.00	256K RAM, two floppy disk drives, mono/graphics card*, multi I/O card	\$880.00	Two floppy disk drives, monochrome monitor	640K upgrade, \$60; 20-Mbyte Seagate hard disk and controller card, \$425; color/graphics card, \$175; color monitor, \$325; multi I/O card, \$85
PC ITS Turbo XT Information and Technology Systems	\$695.00	640K RAM, two floppy disk drives, monitor, mono/graphics card	\$895.00	Two floppy disk drives, monochrome monitor	20-Mbyte hard disk, \$412; color/graphics card, \$65
American Micro XT JR. American Micro Technology	\$699.00	640K RAM, two floppy disk drives, floppy disk controller card	\$857.00	Two floppy disk drives, monochrome monitor	20-Mbyte hard disk, \$405; monochrome monitor, \$168; mono/graphics card, \$75; color/graphics card, \$115
Micro 1 XT Turbo Microsystems Group	\$995.00	640K RAM, two floppy disk drives, floppy disk controller card, monitor, mono/graphics card	\$995.00	Two floppy disk drives, monochrome monitor	21-Mbyte hard disk drive, \$435; color monitor, \$230; color/graphics card, \$95
PC Designs XT (Plain Vanilla) PC Designs	\$995.00	640K RAM, two floppy disk drives, monitor, mono/graphics card, multi I/O card	\$995.00	Two floppy disk drives, monochrome monitor	10-Mbyte hard disk, \$300; 20-Mbytes, \$449; 30-Mbytes, \$559; color monitor, \$325; Hercules upgrade, \$75
WIN Labs XT Compatible WIN Laboratories	\$699.00	640K RAM, two floppy disk drives, multi I/O card	\$1,017.00	Two floppy disk drives, monochrome monitor	21-Mbyte hard disk, \$440; mono/graphics card, \$119; color/graphics card, \$99; one parallel and one serial port, \$50
ANI PC-2 Aphanum Inc.	\$895.00	640K RAM, two floppy disk drives, monitor, mono/graphics card, multi I/O card	\$1,050.00	Two floppy disk drives, monochrome monitor	Three-speed turbo package, \$1,050
THE PC+ THE Computer Products	\$507.00	640K RAM, one floppy disk drive, floppy disk controller card	\$1,063.00	Two floppy disk drives, 20-Mbyte hard disk, monochrome monitor	2nd floppy disk drive, \$81; 20-Mbyte hard disk and controller card, \$415; amber monitor, \$70; CGA, \$163; EGA, \$250
Adtek Turbo XT Adtek	\$895.00	512K RAM, one floppy disk drive, mono/graphics card	\$1,103.00	Two floppy disk drives, monochrome monitor	2nd floppy disk drive, \$89; 20-Mbyte hard disk, \$389; hard disk controller card, \$103; 16-Mbyte tape drive, \$419; green monitor, \$99; amber monitor, \$109; color monitor, \$349; color card, \$136; EGA, \$250
Computer Mail Order PC Clone Computer Mail Order	\$799.00	256K RAM, two floppy disk drives, floppy disk controller card, mono/graphics card	\$1,178.00	One floppy disk drive, 20-Mbyte hard disk, monochrome monitor	One floppy disk drive and one 20-Mbyte hard disk, \$1,099; monochrome monitor, \$79; color monitor, \$288
DLXT Turbo 640 Date-Lite Systems	\$1,099.95	640K RAM, one floppy disk drive, 20-Mbyte hard disk, hard and floppy disk controller cards, multi I/O card	\$1,286.00	One floppy disk drive, 20-Mbyte hard disk, monochrome monitor	High-res monitor, \$120; mono/graphics card, \$70; color card and monitor, \$375
Kammerman Labs XT Kammerman Labs	\$799.00	640K RAM, one floppy disk drive	\$1,378.00	One floppy disk drive, 20-Mbyte hard disk, monochrome monitor	2nd floppy disk drive, \$125; 20-Mbyte hard disk, \$399; high-res monitor and card, \$208; color card and monitor, \$491; multi-function card, \$125
PC's Limited Turbo XT PC's Limited	\$795.00	640K RAM, floppy disk drive, floppy disk controller card	\$1,413.00	One floppy disk drive, 20-Mbyte hard disk, monochrome monitor	2nd floppy disk drive, \$95; 20-Mbyte hard disk, \$440; monochrome monitor, \$169; mono/graphics card, \$150; color monitor, \$499; universal graphics, \$199
Advanced XT/PC Advanced Computer Products	\$699.00	256K RAM, two floppy disk drives, color/graphics card, serial and parallel ports, mouse and mouse software	\$1,467.00	One floppy disk drive, 20-Mbyte hard disk, color monitor	10-Mbyte hard disk, \$457; color monitor, \$331
Victor VPC II Victor Technologies	\$1,095.00	640K RAM, one floppy disk drive, floppy disk controller card	\$1,794.00	One floppy disk drive, 20-Mbyte hard disk, color monitor	2nd floppy disk drive, \$200; 20-Mbyte hard disk, \$800; monochrome monitor, \$169; color monitor, \$595; color/graphics card, \$69
Apparel Turbo PC Apparel Inc.	\$799.00	640K RAM, one floppy disk drive, floppy disk controller card	\$2,400.00	Two floppy disk drives (including 1.2-Mbyte disk), 21-Mbyte hard disk, Limbo EMS, monochrome monitor	2nd floppy disk drive, \$119; 1.2-Mbyte floppy disk, \$399; 21-Mbyte hard disk, \$930; mono/graphics card, \$139; Combo II card, \$85; Limbo EMS, \$451; monochrome monitor, \$120

*Multi I/O card contains two serial ports, one parallel port, one game port, a clock/calendar, and a floppy disk controller card. Mono/graphics card includes a parallel port. *Baby Micro could not specify one

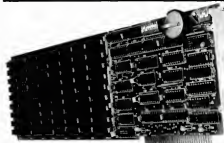
Slots	Power supply (watts)	Extra connector pad on keyboard	Reset key	Keyboard style	Claimed clock speed (MHz)	Controller card	Warranty	IBM EGA compatible	Above Board compatible	BIOS label (date)	Comments on motherboard
8	150	No	No	Old AT	4.77 and 8	Handles two floppy disk drives	1 year parts; 90 days labor	Yes	Yes	No ID	
8	135	No	No	Old AT	4.77 and 8	Handles two floppy disk drives	1 year; 4 months on drive	No	Yes	1 Dec 85	Made in Taiwan
8	Information unavailable ¹	No	No	Old AT	4.77 and 8	Handles two floppy disk drives	1 year parts and labor	Card wouldn't fit in machine	Card wouldn't fit in machine	16 Oct 84	
8	135	No	Yes	Old AT	4.77 and 7.33	Handles four floppy disk drives	1 year parts and labor	Yes	Yes	14 May 86	X Turbo board
8	135	No	No	Old AT	4.77 and 8	Handles two floppy disk drives	90-day standard; 1 year for mother, hard disk drive, motherboard	Yes	Yes	1985, Version 2.0, M Ferney	Made in Taiwan
8	150	No	No	Old AT	4.77 and 7.77	Handles four floppy disk drives	90 days	No	Yes	No ID	
8	135	No	No	Old AT	4.77 and 8	Handles two floppy disk drives	30-day money-back; 1 year parts and labor	Yes	Yes	1 Jan 86	Made in Taiwan
8	150	Yes	Yes (but didn't work)	Keytronics SIS1	4.77 and 6.66	Handles two floppy disk drives	1 year; extension available for extra charge	Card wouldn't fit in machine	Yes	18 Oct 84	
8	135	No	No	XT	4.77	Handles two floppy disk drives	4 months	Card wouldn't fit in machine	Card wouldn't fit in machine	Dec 85 "XT Compatible"	Made in Taiwan
8	135	No	No	Old AT	4.77 and 6	One handles hard disk, other handles two floppies	45-day money-back; 1 year warranty	Had its own EGA	Yes	No ID	Made in Taiwan
6	135	No	No	Old AT	4.77 and 8	Handles four floppy disk drives	90 days on components; 1 year on Adtek workmanship and materials	No	Yes	2 Dec 85	ACS 1000
8	150	No	No	XT	4.77	Handles two hard disks and two floppies	90 days	Card wouldn't fit in machine	Yes	1985	Made in Taiwan
8	135	No	Yes, on back	Old AT	4.77 and 8	Handles one hard disk and two floppies	6 months on system and one year on hard disk drive	Card wouldn't fit in machine	Card wouldn't fit in machine	16 Oct 1984	Made in Taiwan; Turbo system board
8	135	No	No	Old AT	4.77	Handles four floppy disks	1 year parts; 90 days labor	Yes	Yes	15 Apr 84	
8	135	No	No	Old AT	4.77 and 6.66	Handles two hard disks and four floppies	30-day money-back; 1 year warranty	Yes	Yes	1 Jan 86	X Turbo Board
3	100	No	No	XT	4.77	Handles one hard disk and two floppies	90 days limited	No	No	Tohiba	
5 ¹	130	No	Yes, on front of unit	Old AT	4.77	Handles two hard disks and two floppies	30-day money-back; 90-day warranty	No	Yes	No ID	
8	135	Yes	Yes	Keytronics SIS1	4.77 and 7.33	Handles four floppy disks	Limited lifetime on parts and labor on motherboard; 90 days at site	Yes	Yes	20 Feb 86, IBM PC	X Turbo Board

Power supplies varied from unit to unit. ¹Although Victor Technologies claims that two of these slots are 16-bit, they don't conform to IBM 16-bit slot specifications.

— Indicates Editor's Choice

APPARAT INTRODUCES THE...

LIMBO*



You've got a problem. You have 640K of RAM and you still run out of memory! Go to your favorite computer store. Then ask about expanded memory cards. See the problem? Just too many to pick from. Now, ask to see the **LIMBO™**. No problem. There's only one. Ours. Except you probably don't know a **LIMBO** from a dance step. Maybe you guessed that it is an expanded memory board that supports the Lotus/Intel/Microsoft Expanded Memory Specification (EMS). And that it has a 2 MB capacity and up to 8 MB is supported by the memory management software.

The **LIMBO** includes a clock/calendar and 8 banks for use by either 64K or 256K DRAM. Software includes the EMS memory manager, EMS compatible RAM Disk and print spooler.

The **LIMBO** is manufactured by Apparat in Denver, Colorado, and is covered by Apparat's Exclusive Limited Lifetime Warranty. So you can be confident that you won't find yourself out on a limb. (We've been in business since 1978.)



Need an EMS multifunctional board? Ask to see the **LIMBO II**. The **LIMBO II** has a 1.25 MB capacity with a parallel port, a serial port, a clock/calendar, and game-stick adapter. **LIMBO** and **LIMBO II** have flexible starting addresses and can be set to fill system memory to 640K, with the remaining memory to be used for EMS. This eliminates the need for conventional RAM boards.

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THE ONCE AND FUTURE PC

There are those who believe that in the near future, there will be no room for IBM at the low end of the PC market. Loyalty from the business community may not be enough. What, then, is Big Blue to do?

Most companies can run a sale without much fanfare, but when IBM tries to unload some of its storeroom goods, the eyebrows go up and the crystal balls come out. On April 2, IBM announced a formal price cut for the PC through its Product Centers—an act that spawned a series of promotional sales by authorized IBM dealers. And again, in early July, it slashed dealer prices, which is likely to result in further retail cuts. To many, the PC price cuts signal the final episodes in the IBM PC's life cycle. IBM watchers are having a picnic as they nosh on the fate of the classic PC.

The infants' trembles of the PC price cuts are the low-cost compatibles. By some calculations, IBM has lost as much as half of its PC business this year because of these machines. While it's true that IBM's PC price cuts are due in part to rapid advances in technology, the proliferation of low-cost compatibles triggered the move. If it weren't for clone makers, IBM would still be bringing out new technology at a snail's pace, and the dual-floppy PC would still be a viable business machine.

The rumor mill is still abuzz with talk of a new IBM PC—the PC II—sporting the latest technical advances and serving as a vengeful slap on the wrist to makers of low-cost compatibles. But IBM's revenge may also surface as a new line of products containing proprietary components—thereby putting an end to the heyday of open architecture. As low-cost manufacturers march off with chunks of the traditional PC market, driving PC prices down to unheard-of lows and creating the impetus for an accelerated IBM product cycle, the future of the old, faithful IBM PC is about as stable as a glass house on the San Andreas Fault.

On June 18, IBM's CEO, John Akers, warned that if parts of the com-

puter industry become "increasingly commoditylike"—where price becomes the main factor—"you will probably see IBM departing from those parts." He also added that IBM prefers "high-margin sales."

Days later, when IBM was asked about the future of the PC, the official comment was, "We intend to remain competitive in this industry." An IBM spokesperson went on to say that "IBM perceives a need to continue differentiating its products from its competitors in order to remain in a leadership role in the industry." Without referring to the IBMese handbook for translation, it seems obvious that the company will concentrate on the PC product line and interconnectivity issues and let the PC fade gradually into oblivion. This strategy will undoubtedly make the next round more difficult for low-cost compatibles.

THROWN TO THE CLONES For the short term, makers of cost-effective compatibles see the IBM PC price cuts as a decided victory. The IBM price cuts come too late and are too minimal to pose any real threat. "The expense of the PC and its 3-year-old technology drives users to buy low-cost compatibles," says Patrick Griffin of PC Designs (Tulsa, Oklahoma). "Most people don't need those three letters behind them anymore." PC Designs makes a \$995 XT clone dubbed the "Plain Vanilla."

THE CLONING OF AMERICA In the past, low-cost PC compatibles were noticeably different from the real McCoy, but savvy customers are forcing makers to minimize these differences. Low-cost compatibles have become increasingly dependable. However, it's still common to find oddly named, identical-looking low-cost compatibles with flimsy cases,

light coats of paint that's instantaneously scratched, plastic keyboards, cheap disk drives, slow write times, and BIOSs such as the Taiwanese ERSO, and to some people these shortcomings may be worth the financial gain. User savings may amount to as much as \$600 per machine. "With the Koreans coming in, there will be further price degradation," comments Rick McCabe of Micro 1 in San Francisco. "I don't see how IBM can stay in the market."

McCabe is typical of the new breed of compatible manufacturer. He comes to the industry with expertise and a "now's the time" attitude. The overhead for his operations is low, and he has begun to penetrate the business markets near home.

According to McCabe, about 75 percent of the currently available low-cost compatibles don't have the appropriate level of FCC approval to permit them to be sold in retail stores. Pressure from IBM helped make FCC approval necessary to begin with, and at first the requirement kept many low-cost compatibles out of the market and limited IBM's competition. But now that established guidelines exist, many low-cost compatibles are meeting these guidelines and gaining FCC approval. Ironically (thanks to IBM's efforts), this official stamp of approval is increasing their respectability.

Another clone barometer is the motherboard. Originally, about 75 percent of all low-cost compatibles had two-layer motherboards. The four-layer motherboard construction (à la IBM PC) offers greater stability. Clone makers are adopting the standard.

While IBM has an aversion to low-profit commodity markets, the manufacturers of low-cost compatibles are not opposed to slumming it. As they meander

Santa Claus is Coming to Town!



Maps



Pictorials

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ONCE AND FUTURE PC

(continued)

into retail markets, it seems likely that we'll find them on the shelves of favorite discount houses. "Everyone should be grateful for the existence of the low-cost compatibles, especially Americans who insist on remaining True Blue," says David Rothman, author of *The Silicon Jungle* (New York: Ballantine Books, 1985). "Without competition from the low-cost compatibles, IBM would charge even more than it does."

Low-priced PC compatibles might give the crossover market a kick in the pants that would blur the rigid distinction between business and home computers. Because of the new low prices (some authorities predict that prices will hit the \$300 to \$400 range by Christmas), the market for PCs has expanded. The \$1,000 mark is the magic number that could turn the IBM PC into a commodity market.

BIG BLUE'S BLUEBLOODS PC compatibles may be poking up like weeds in the IBM lawns of many businesses, but bastions of loyalists still exist. At U.S. Trust and New York Life Insurance, for instance, there is a de facto IBM allegiance. There is also a no-nonsense movement to press on past the PC standard. Almost 6 months ago, U.S. Trust made PC-XTs the minimum in-house configuration, and there's already talk of upgrading to an AT standard. "I'd consider a non-IBM machine for personal use," says Belinda Ulrich, assistant vice president at U.S. Trust, "but never for our business environment."

Even in academic circles, where the money runs thin, there's a certain commitment to IBM. At Rockefeller University, Dr. Paul Rosen commented, "From an institutional point of view it makes sense to stick to IBM because of service and support. For those who don't have

the budget money, low-cost compatibles are an answer, but those who have used them find that some of the more laboratory-oriented programs don't work." Rosen acknowledges that IBM is more conservative—often less technologically advanced—than some of the compatible manufacturers, but he feels the reduced anxiety about repairs and support make the trade-off worthwhile.

Retail outfits are understandably supportive of the PC's continuing success, although two large IBM dealers recently rocked the boat by introducing house-brand PC compatibles. Computer Factory spokesman Ed Anderson was enthusiastic about recent PC sales and says that the demand for the machine is still very high. Commenting on the price cuts, Anderson said that "IBM has made it possible to use the PC as an effective product to compete with the low-cost compatibles."

For many, buying the IBM label is buying a continuing tradition, and buying a no-name compatible is a dangerous game. Makers of cost-effective compatibles, without much knowledge about the PC line, operate at a considerable disadvantage. If IBM tightens the reins on the PC's open architecture, the reliability of low-cost compatibles would be more in question than it already is. Software developers write programs to run on the IBM PC itself, so for the cautious, the uncertainty factor is overwhelming. "You never know if they're going to work (or in some cases even arrive) until the moment of truth," says Rosen. A gamble may be the entrepreneurial way of life, but it is not the modus operandi for MIS or DP management. A poor choice of a PC compatible could cost someone a job.

IBM seems resigned to the fact that the PC may be a has-been, but the PC line

is alive and well. The company is banking on its loyalists to rally 'round as the compatibles market mounts a tantalizing price campaign. Large corporations will probably remain loyal, but the less affluent may not be able to resist the temptation to buy one and a half low-cost compatibles for every real PC.

Businesses that bought hoards of full-price PCs in 1983 are faced with the fact that they are working with anachronisms. Thanks to competition from low-cost compatibles, technology is moving faster than the anticipated active desk life of the machine.

Although IBM pooh-poohs this new "commodity" market for PCs, a look at the numbers offers proof that price is bringing IBM PCs home. According to Link Resources, a market research firm, IBM has been steadily increasing its share of the home market—from 7 percent in 1984 to 11 percent in 1985. When questioned, those who planned computer purchases this year said that compatibility with PCs at work was one of the key criteria. Twenty-nine percent of those who do not own a computer but plan to buy one this year indicated that they'd like to buy an IBM (the first time IBM ranked higher than Apple).

Clearly, IBM's message to the business user is to look beyond the PC, but perhaps IBM is burning its bridges in the "commodity" business prematurely. Why shouldn't the folks who brought us the PCjr and envisioned a computer on every desk take a crack at a new-age market? Despite compelling rationales, if IBM were to compete with the low-cost compatibles on price, the latest IBM acronym would be: I Believe in Miracles!—**Robin Raskin**

Robin Raskin is a frequent contributor to PC Magazine.

■ THE CHEAPEST PCs EVER



Benchmark Tests: Low-Cost Compatible PCs and XT's (Normal Mode)

NOP

The 128K **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K-byte loop.

Floating-Point Calculation

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentials, and logarithmic and trigonometric functions. This test program uses the floating-point library included with the Microsoft C Compiler 3.0.

Conventional RAM

The **Conventional RAM** benchmark test allocates 256K bytes of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory.

Disk Access

The **Disk Access** benchmark test from Core International measures the hard disk's seek time, or how fast the drive responds to the disk controller's instructions (in milliseconds). The test program performs three measurements on the speed at which the drive head moves: track to adjacent track, track to randomly selected track, and the average of a series of random track accesses. Only the results for a series of random track accesses are shown here.

1-2-3 Routine

The **1-2-3 Routine** benchmark test for spreadsheet applications, designed for a 640K-byte environment, assesses the computational speed and RAM management capabilities of the machine by using a 1-2-3 macro that performs a series of both global and individual worksheet tasks. The macro copies and recalculates a 10-cell range 499 times, moves 1,000 cells, deletes 1,000 cells, and then systematically clears the spreadsheet.

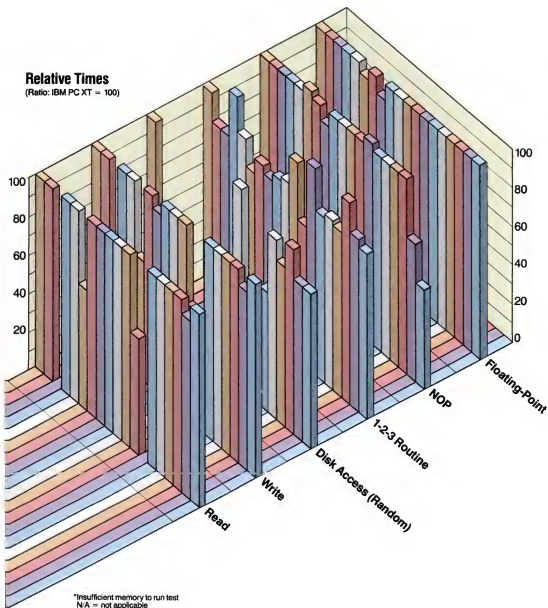
Performance Times

(Times given in seconds and decimal seconds)

Product	Price as tested	Conventional RAM Read	Conventional RAM Write	Disk Access Random	1-2-3 Routine	NOP	Floating- point Calculation
IBM PC XT	\$3,315	5.93	5.99	106.91	54	10.11	9.95
Wisetek Turbo XT	\$ 710	5.93	5.93	N/A	46	10.14	9.92
STD Turbo 86	\$ 788	*	*	N/A	46	10.16	9.94
Baby Micro XT	\$ 880	5.93	5.93	N/A	59	10.11	9.92
ITS Turbo XT	\$ 895	5.96	5.96	N/A	59.4	10.11	9.92
American Micro AT JR.	\$ 957	3.71	3.68	N/A	41.4	10.55	9.50
PC Designs XT	\$ 995	5.93	5.93	N/A	46	10.11	9.92
Micro 1 XT Turbo	\$ 995	5.60	5.60	N/A	43.6	9.37	9.12
WIN Labs XT Compatible	\$1,017	5.96	5.96	N/A	46	10.11	9.94
ANI PC-2	\$1,050	5.93	5.96	N/A	46.8	10.11	9.89
THE PC	\$1,083	5.93	5.99	110.45	55	10.14	9.92
Adtek Turbo XT	\$1,103	3.52	3.55	N/A	39	10.14	9.15
Computer Mail Order PC Clone	\$1,178	*	*	N/A	57.8	10.52	9.89
DLXT Turbo 640	\$1,286	5.99	5.99	65.30	46	10.11	9.94
Kammerman Labs XT	\$1,378	5.96	5.96	89.16	46.8	10.11	9.92
PC's Limited Turbo XT	\$1,413	5.93	5.93	87.11	46	10.05	9.92
Advanced XT PC	\$1,487	5.99	5.99	101.77	56.2	10.16	10.00
Victor VPC II	\$1,794	5.49	5.49	75.90	48	7.03	9.92
Apparat Turbo PC	\$2,400	5.93	5.93	75.90	46	10.11	9.89

Relative Times

(Ratio: IBM PC XT = 100)



*Insufficient memory to run test
N/A = not applicable

■ THE CHEAPEST PCs EVER



Benchmark Tests: Low-Cost Compatible PCs and XTs (Turbo Mode)

NOP

The 128K **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K-byte loop.

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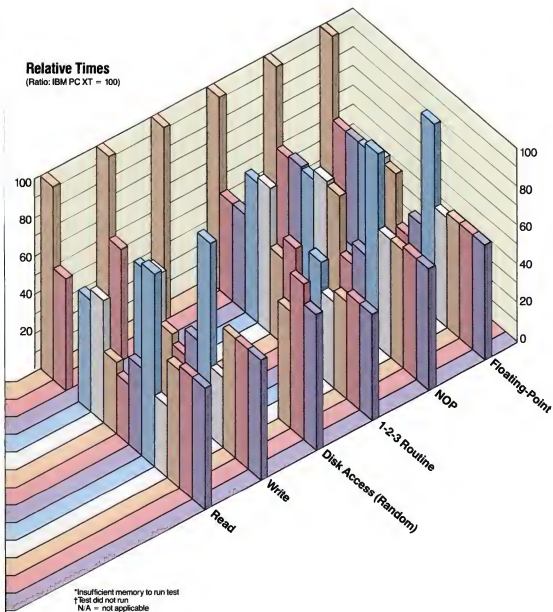
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Wisetek Turbo XT	\$ 710	3.41	3.44	N A	27	5.82	5.58
STD Turbo 86	\$ 788	"	"	N A	27	5.99	5.77
Baby Micro XT	\$ 880	3.44	3.41	N A	39	5.82	5.60
ITS Turbo XT	\$ 895	3.79	3.73	N A	40.8	6.37	5.93
American Micro AT JR.	\$ 957	2.20	2.20	N A	23.8	6.23	5.71
PC Designs XT	\$ 995	1.87	1.87	N A	30	3.19	2.97
Micro 1 XT Turbo	\$ 995	2.69	2.64	N A	1	4.31	4.26
WIN Labs XT Compatible	\$1,017	5.93	5.96	N A	32	10.11	9.89
Adtek Turbo XT	\$1,103	2.17	2.14	N A	24	6.15	5.58
DLXT Turbo 640	\$1,286	3.63	3.68	65.3	28	6.18	5.93
PC's Limited Turbo XT	\$1,413	3.73	3.76	87.11	30	6.40	5.93
Apparat Turbo PC	\$2,400	3.79	3.73	75.90	30	6.43	5.96

Relative Times

(Ratio: IBM PC XT = 100)



■ THE CHEAPEST PCs EVER

1-2-3—a test that used to stump most compatibles—although the WIN Labs XT Compatible ran into problems keeping its screen in focus while in 1-2-3. Some ran XT diagnostics faultlessly, while others produced minor errors (earlier models of the IBM PC also produce errors in XT diagnostics).

If you're a BASIC programmer, note that the version of Microsoft GWBASIC you buy to use with your compatible may not be fully compatible with it. The reason for this is that Microsoft does not sell BASIC; it licenses it to larger manufacturers of PC compatibles. GWBASIC is not a generic product. Every BIOS, to avoid copyright infringement, must have minor differences from all other BIOSs. GWBASIC includes a lot of special screen-handling and other features that are accessed through the BIOS, so it must be customized to your machine before these features can work properly.

Hardware compatibility can suffer for a number of reasons. Ridiculous as this seems, in four of the machines tested—the Advanced XT/PC, the WIN Labs XT Compatible, THE PC+, and the DLXT Turbo 640—it was difficult or impossible to fit standard-size PC expansion cards into the slots. Three of the machines—the Advanced XT/PC, the Micro I XT Turbo, and the DLXT Turbo 640—could not run the Enhanced Graphics Adapter.

USER COMPATIBILITY Compatibility with the user is an equally important but often overlooked issue. Since computers don't run themselves, ergonomic considerations can have a major effect on productivity. The keyboards on these machines generally run from poor to bad, unless you like nonstandard layouts (most), mashed-potatoes touch (most), and annoying beeps with each keystroke (WIN Labs XT Compatible). The best keyboard we found was the Maxiswitch model, which comes with the PC's Limited Turbo XT and the American Micro AT JR. Also good are the keyboards supplied with the ITS Turbo XT and the Baby Micro XT. There are \$2,000 machines out there with worse keyboards, and in defense of the clones, nearly all of the low-cost machines come with goodies like separate numeric keypads, Reset keys, and AT-style layouts. I can live

without all of these, but someone else might crave them.

Another potential ergonomic weak point with low-cost compatibles is screen

■ **Business users can more easily take a chance with a low-priced machine than can home users. Lack of support may not be a problem.**

quality. Most of the systems tested were shipped with either green or amber monochrome displays; the ones on the Advanced XT/PC, the PC's Limited Turbo XT, and the Apparat Turbo PC produced grainy text. Since nearly all of these machines are sold as empty boxes—that is, the monitors are optional—the best advice in these cases is not to go with the generic display offered by the mail-order house but to spring for something a little more reputable and of higher quality. This can mean paying more for the monitor and display adapter than you do for your computer, but you can think of it as saving so much on your computer that you can afford better display technology.

Rarely has *PC Magazine* done a survey in which so many people have expressed so much interest in the outcome. "Let me know how the testing comes out," went the typical query, "so I can buy one to use at home/for my kid/for my niece," and so on. Pundits are predicting prices as low as \$300 for a base system by Christmastime, and we all remember what low prices did for PCjr sales a couple of years ago. Is cost really the inhibiting factor in the home-computer market?

HOME BREAKTHROUGH If it is, there are still a number of issues at stake for the home-computer buyer, the primary one being risk assessment. Business users can generally more easily afford to take a chance with a low-priced machine than

can home users. Lack of support may not be a problem: if it breaks, many businesses have someone in-house who can fix it or can afford the monthly drain of a service contract. If it breaks for good, those are the breaks; all it takes to recoup the loss is an adept tax accountant. On the other hand, if a home user gets a bad piece of hardware, he or she can really be stuck—with \$75-per-hour-plus repair bills, or, worse yet, a high-priced paperweight.

Also, even experienced users will find the level of documentation that comes with most of these machines appalling. Few of them have specific documentation other than poorly written (translated?), inaccurate summaries of motherboard features and capabilities. Only one machine's documentation earned praise; that was the Victor VPC II.

One of the risks that a home user can deal with better than a business can, though, is the question of expandability. Most of the low-cost compatibles feature a full eight expansion slots. With the Advanced XT/PC, however, your \$895 buys you only three expansion slots. With 640K bytes of RAM and color/graphics on the motherboard, home users are unlikely to need much else. But business users still might want a mouse interface, port adapter, a micro-to-mainframe terminal emulator, maybe some expanded RAM, a hard disk card or a Bemoulli Box interface, and tape-backup controller card—and God forbid you should later decide that you can up your productivity by installing a local area network!

Lack of support, lack of documentation, and dubious quality control make mail-order PCs in general—and the cheap clones in particular—a bad risk for the home user. But if you're a businessman looking for an inexpensive way to automate your secretarial pool or to set up workstations on a network, then taking a risk on one of the better mail-order units like the Victor VPC II or the ITS Turbo XT might not be such a bad idea. ☐

Paul M. Stafford is a staff editor at PC Magazine. He was assisted in the testing for this article by Christopher Barr, Vincent Puglia, Joe Desposito, Donald P. Willmott, Bill O'Brien, Mari Pfeiffer, and Gretchen Luchsinger.

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OPTICAL OVERVIEW

What's Coming in CD-ROMs and WORMs



If your company has rooms full of computer tape archives, expect them to be replaced by write-once laser disks within 10 years. If you use any reference books that are 2 or more inches thick, plan to attach a laser disk reader to your personal computer sometime during the nineties. If your company now buys tapes of data for use on the corporate mainframe, expect those tapes to be replaced with CD-ROM optical disks. And if you have a database that you believe could make you a bundle if only you had a way to reproduce and distribute it, then start studying CD-ROM and optical technology now.

Optical storage technology is the alternative to standard magnetic storage—our familiar floppy disks and hard disks. It may radically expand the kinds of things we can do with PCs over the next few

years. The technology itself, which uses finely focused laser beams to cram at least 50 times more data onto a given number of square inches, may bring many mainframe-scale applications onto your desk.

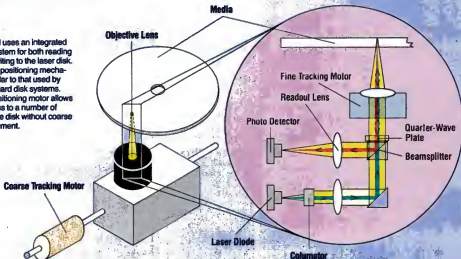
Apart from their data density, optical media have other inherent advantages. Because they are read by a light beam, the reading mechanism can be considerably farther away from the recording surface, making head crashes a thing of the past. The surface can also be protected from physical damage like fingerprints and scratches by a transparent plastic coating. And the incredible bits-to-burn data capacity means that data can be recorded with a great deal of redundant error-checking information, so that even if a part of the disk is physically damaged, actual data loss can be minimal.

The CD-ROM and other optical disks are likely to be as revolutionary in storing and preserving data as their predecessor, the audio CD, was in making music a purer pleasure.



How a WORM Works

The WORM uses an integrated focusing system for both reading from and writing to the laser disk. The coarse positioning mechanism is similar to that used by expensive hard disk systems. The fine positioning motor allows direct access to a number of tracks on the disk without coarse motor movement.



CD-ROMs Optical storage media and the devices that use them come in three classes, each destined to be used in different circumstances. The class that will be most common in the next few years is read-only optical media, which are the descendants of the last decade's 12-inch videodisks and, more directly, of the audio compact disks of the eighties. These 5-inch silvery platters go by the name of Compact Disk Read Only Medium, or CD-ROM. A CD-ROM can hold about 550 megabytes of usable data—equivalent to over 400 of the high-density 1.2-megabyte disks used by the PC AT or to over 1,500 old-fashioned 360K-byte disks.

Link Resources Corp., a high-tech market-research organization, expects that by 1990 nearly a million of us will have purchased CD-ROM drives for our computers and that the user base will be growing by half a million a year. Investors will have poured \$2.3 billion into the CD-ROM industry by that time, and Link expects us to be spending four times as much on information products as on the drives. The rapid and striking success of each of the two technologies that are brought together in

CD-ROM—audio CD and personal computers—lends some credibility to these optimistic predictions.

A CD-ROM is physically identical to the audio CD. Unlike the phonograph records and tapes that preceded it, the audio CD is a digital medium. An hour of music is translated into billions of bits of digital data, and those discrete bits are physically pressed into the CD's surface, taking the form of infinitesimal pits. The CD player in your living room spins the disk under a fine laser beam, reads the digital data, and uses digital-to-analog conversion circuitry to turn it back into sound. Adapting this device to function as a computer peripheral is relatively easy. You must build it without the digital-to-analog converter so that the bits can be fed directly into the computer, where they can be handled just like any other data. Then adapt the audio CD player's exiting random-access capability (which, for example, lets you skip directly to music track 5) so that it is controlled by the host computer, rather than a button on the front of the player.

The disks themselves can be stamped out in exactly the same factories using ex-

actly the same processes as audio CDs; the factory doesn't care whether the data is the music of the New York Philharmonic or the entire text of *The New York Times*. It is this already-existing consumer-scale mass-production potential that most distinguishes CD technology from any of its computer-industry predecessors.

WORM The second form of optical medium is the write-once disk. Like the CD-ROM, it stores information in the form of little depressions in the recording surface. Unlike the CD-ROM, the drive you buy for your office is capable of creating, as well as reading, these depressions. Because they are irreversible physical changes in the disk's surface, like the permanent grooves in a phonograph record, they cannot be altered, although they can be read as often as desired. The disks are therefore often called write-once, read-mostly—or WORM.

Although the permanent irreversibility of its data would be a considerable disadvantage if the WORM were the only storage device your computer had, the anticipated uses of write-once technology make

■ OPTICAL TECHNOLOGY

a virtue of this necessity. Indelible records delight accountants, who can poke back into the history of financial transactions as much as they want. The physical durability of the medium, combined with its enormous storage capacity, makes it a great alternative to huge filing cabinets or microfilm or tape storage of corporate archives that shouldn't be destroyed.

Write-once technology is considerably less standardized than CD-ROM. Disks manufactured by different companies are not the same size, and their plastic protective shells are not the same shape. Because they record data at different densities, their capacities range from 200 megabytes to 1 billion bytes per disk.

ERASABLE OPTICAL STORAGE The third optical storage medium, erasable optical storage, is the most difficult one to achieve and will take the longest to reach your desktop. You can think of it as a fairly straightforward extension of the current concept of magnetic disk storage—it provides ten times the storage capacity and can be erased, either section by section or an entire disk at a time.

EXPLOITING THE CAPACITY

What will personal computer users do with the vast storage capacity of optical media? Will 550 megabytes on a CD-ROM simply encourage software developers to further excesses of fleshy programming? Will our spelling checkers go from 50,000 common words to 500,000 obscure ones in each of six languages? Or will optical media encourage different kinds of information manipulation rather than simply extend the scale of what we do now?

Consider all the applications that aren't now on your microcomputer because they involve too much data for your current hardware to handle. Look around your office, for example, for any reference book that's more than 2 inches thick. Sure, *SideKick* and similar programs can handle your personal telephone directory of a couple of hundred people, but not the metropolitan-area phone book, which, even with today's larger hard disks, has never been a PC-manipulable product.

The volume production cost of a CD is already under \$10—the music industry has seen to that. It's only a matter of time be-

fore the phone company (or someone else) figures out that a computer-manipulable CD-ROM phone book is cheaper than paper. Similar logic will turn that shelf-full of *PC Magazines*, the encyclopedia, the monthly *Official Airline Guide*, and that stack of old *Wall Street Journals* in the corner into fully indexed, fully searchable CD databases.

It's happening already: Ziff-Davis Publishing Co. (which publishes *PC Magazine*), the *Grolier Encyclopedia* people,

■ It's only a matter of time before the phone company (or someone else) figures out that a computer-manipulable CD-ROM phone book is cheaper than paper.

and Dow Jones and Co. (who publish *The Wall Street Journal*) all already have optical disk products (see sidebar "Premier Reference Tool of the '90s").

2-D IMAGES Think of a road map, for example—or any other two-dimensional image, such as an X ray or a photograph. Storing any of these in quantity on magnetic media has been impractical, but a single write-once disk could store hundreds or thousands of images, depending on the resolution required. And the images, once in digital form, could be located and reproduced easily—a great way to index a photo library or to supply X rays to medical school classes. These applications aren't just in the future: Chorus Data Systems of Merrimack, New Hampshire, already offers its Color PhotoBase system, a database management system for photos or other images stored on optical disks, and others are sure to become available. The federal government is experimenting with a CD containing digitized images of thousands of different blank forms. A personal

computer, CD-ROM reader, and laser printer become an on-demand forms printer, replacing roomfuls of forms inventory.

Huge databases, such as census or survey data, can be purchased on computer tape, but unless you happen to own a mainframe, they are useless. In fact, many large information collections have not been widely available simply because they have limited application if they cannot be manipulated by a computer. Up until now there has been no way of delivering them to our millions of microcomputers. Consider a simpler, more down-to-earth application, ZIP-plus-four coding of the thousands of addresses in microcomputer-based mailing lists used by any big company. You needn't wait: right now, Omni Computer Systems of Chestnut Hill, Massachusetts, will sell you FLASH+4, a system for adding those extra four digits. It is built around a database of 20 million address ranges and their associated ZIP-plus-four codes, which are contained on two optical disks.

Filled-out paper forms often contain far more information than can comfortably be accommodated in traditional databases. A clerk can key the account number, date, and amount from an American Express voucher or assign and key a code for your insurance claim, but these methods can't capture the signature on a voucher or interpret poorly written figures or bizarre explanations of mishaps on claims. The huge, nonerasable capacity of write-once technology makes it practical to store all this information in the form of a scanned image of the paper. A single American Express voucher, scanned with the resolution of a good facsimile machine, would take something like 75K bytes; so a billion-byte, 12-inch write-once optical platter could contain permanent records of more than 10,000 such images, plus enough indexing information to locate them easily. The platter would take much less space and would be much easier to manipulate than microfilm or similar media, and a "copy" of the voucher could be easily telecommunicated to the nearest American Express office when a customer claimed he hadn't ever signed for \$400 for the Va-Voom Escort Service. Today, you can spend millions on a scanning and optical

PREMIER REFERENCE TOOL OF THE '90s

Although still in its infancy, CD-ROM applications development is already creating products that can be used to greatly improve the reference capacities of schools and libraries and, one day soon, the home consumer market.

With more than a dozen applications already being sold and several dozen more in development, CD-ROM is developing into the premier reference tool of the 1990s. It is commonly expected that CD-ROM will take the place of such large reference database systems as Dialog (Palo Alto, California) and BRS (Latham, New York). In fact, most of the early CD-ROM applications have been disks containing databases from these services. Not only do these already have established markets receptive to CD-ROM technology, they are already digitized. This eliminates the largest single expense associated with CD-ROM applications development; the conversion of a shelf full of reference books into digital form—whether by a combination of scanners and extensive correction or by hand entry—is labor intensive and, as a result, costly.

ERIC One of these early CD-ROM products for the PC is the *Educational Resources Information Center (ERIC)* database of the U.S. Department of Education. One of the most heavily used of all the on-line databases, the early publication of *ERIC* is "a major coup" for producer SilverPlatter (Wellesley Hills, Massachusetts), a leader in CD-ROM development, and for the CD-ROM industry in general, says SilverPlatter's U.S. sales manager Christopher G. Pooley. It provides full references and summaries of thousands of papers on all aspects of education from preschool through postgraduate. It is of great interest to undergraduate education majors, graduate students in education and related areas, professional educators, and many professionals in such related social

sciences as psychiatry and child development.

Like all SilverPlatter products, *ERIC* is accessed using special software that comes on a separate floppy disk. This access software, developed at SilverPlat-

■ It is commonly expected that CD-ROM will take the place of such large reference database systems as Dialog and BRS.

ter's home base in London, gives the experienced user the same efficient Boolean search techniques found in the large databases, using standard commands or logical variations where commands are not standard. For the inexperienced user, it offers a full set of help screens and menus. Thus, if you wish to search for articles on the hearing impaired, for instance, you can enter those two words as key words for an initial search. The software will search the entire disk (usually in less than 10 seconds) and give you the number of articles with "hearing," the number with "impaired," and the number with both coming together. If you decide to narrow the search further, you can ask for articles with that phrase in the title. You can ask for those published in 1986 or only those by a particular author. At any time you

can end the search to look at the articles found or step back to an earlier point in the search and take a new approach. Thus, although experienced searchers may be able to find the precise information they want more quickly, rank novices also can use *ERIC* or any SilverPlatter products.

This fact is important to Pooley. He expects that libraries will allow users to search their CD-ROM disks directly, giving individual users experience working with them; heavy users will soon become interested in having their own copies of the disks they use most at their desks. Currently, most CD-ROMs are priced too high for the average user to afford—*ERIC*, for instance, costs \$2,000 for its three disks. This price, however, reflects its traditional limited library market. If a larger market evolves, the U.S. Department of Education could drop the price and make more money selling larger numbers of copies. Eventually, many of the independent producers who own the rights to the disks may choose this course.

GROLIER'S ENCYCLOPEDIA In fact, some already have. One of the first and most famous CD-ROMs is *The Electronic Encyclopedia* created by the New York-based Grolier Electronic Publishing. Designed as a consumer disk even though no consumer CD-ROM market exists as yet, it is priced below the cost of the printed encyclopedia at \$199 plus \$25 a year for a subscription to an annual update that consists of an entire new disk. This is undoubtedly the best buy for anyone wishing to own his own CD-ROM. The disk holds the full text of the *Academic American Encyclopedia*, the same

one available on The Source, CompuServe, GENie, and nine other consumer and professional database services.

Like *ERIC*, *The Electronic Encyclopedia* is fully searchable, allowing users to find the information they need much more quickly than they can in the printed encyclopedia. In fact, says Grolier's national sales manager John Croll, it makes it possible for you to find information that would be impossible to find manually using a conventional index. A key word search for information on the U.S. Civil War, for instance, would turn up not only the obvious articles on famous battles and well-known personages but passing references in the histories of many other people and places.

Although the home consumer market is not yet ready for *The Electronic Encyclopedia*, public libraries, secondary schools, and colleges and universities are. Even some businesses have bought copies, although Grolier did not expect to find a market in corporate America. At the price, many potential users of CD-ROMs may find *The Electronic Encyclopedia* worthwhile as an introduction to the technology. If so, they seem to be getting a good impression. Croll says Grolier has been very pleased with the lack of technical problems associated with the disk, which was created for Grolier by Philips, and with its associated software and hardware. The disk runs on Philips, Sony, and Hitachi drives for the PC. Most service calls, Croll says, come from new users unsure of how to set up the systems or initialize the software. Once the systems are up and running, they seem to give users practically no problems at all.

One of the major attractions of CD-ROM applications is their portability. Databases are not universally available. In third-world countries, phone service is sometimes chancy inside the country, while transatlantic calls are not to be undertaken lightly. Even inside the United States, a librarian may not be able to get onto a particular database because all the access ports are in use or the computer system itself is down. A local copy of the

database on a CD-ROM eliminates all of these problems.

CLASSICAL GREEK When the database is not easily accessible, such problems are only heightened. This is the case with the *Isocrates* (*Thesaurus Linguae Graecae*) database of Greek texts up to A.D. 600. Developed at the University of California at Irvine, this product is of intense interest to classical scholars. Instead of providing the service on-line, however, the developers sell copies on

■ One of the major attractions of CD-ROM applications is their portability. Databases are not universally available.

tape that universities may install in their own mainframes. This is the logical approach because of the lengthy nature of many of the searches, which serve the needs of literary analysis rather than scientific research. A typical search might be for uses of a particular phrase by an author—such as Homer's famous "wine-dark sea." It might yield several hundred references, and each is likely to be important to the searcher since in each the word or phrase may have a slightly different meaning. This kind of search would take up so much time and yield so many references it would probably be prohibitively expensive at \$10 a minute on BRS. However, many colleges do not have the computer space available for the 192-megabyte *Thesaurus*.

Such a database does fit easily onto a CD-ROM disk, a fact that has not escaped the notice of Brown University in Providence, Rhode Island. Brown's extensive computer department is interest-

ed in developing CD-ROM applications for the new IBM RT PC and found the *Thesaurus* ideal because of its size, the obvious need for it, and the lack of copyright problems with the texts. The texts are being combined with extensive search software, and although it is still under development, the disk itself has been successfully mastered. Ellie Myllnas, the graduate student handling the Classics Department end of the development, points out that when this application does become available it will be particularly beneficial to professors in smaller schools. "Today, most of them do not have access to the *Thesaurus* at all," she said. "When this is finished, they will be able to have their own private copies running on their own desktops."

Although CD-ROM is technically the same, right down to its dimensions, as the compact laser disk that has revolutionized the music recording world in the last 2 years, no one has yet put out a CD-ROM with graphics and sound. Sony, Philips, and Hitachi have proposed a new standard called Compact Disk Interactive, or CD-I, that will incorporate sound and pictures with text. The new standard looks toward a time in the not-too-distant future when televisions, stereo systems, and home computers will be combined into a single unit. Compact disk players will be an integral part of these home entertainment centers, and those players will be equally capable of reading disks containing music, movies, or data. For the present, however, CD-I, which was only agreed to early in 1986, is a standard on paper only. No hardware or disks have yet been created that meet it.

DOMESDAY PROJECT Not all CD-ROM developers are waiting for CD-I, however. For the last year a team at the BBC in London has been compiling a unique CD-ROM disk designed to chronicle Great Britain as it was in 1086. Called The BBC Domesday Project after the famous census and tax roll of England made in 1086, it is the most ambitious CD-ROM project yet undertaken. It is intended to provide a complete picture

■ OPTICAL TECHNOLOGY

(*"Premier Reference Tool of the '90s"* continued)

of what it is like to live in Great Britain. It uses moving and still pictures, with sounds and text arranged both in narrative and searchable form.

Much of the raw material is being gathered by schoolchildren. Teams from 14,000 schools (roughly half of all U.K. schools) are collecting information on the 4- by 3-kilometer communities they are in, while similar teams of Scouts, Girl Guides, Womens' Institutes, and National Farmers' Association members are covering 2,000 rural communities. Each community package consists of three photographs, audio recordings, a map, and 20 screens of text on the subject "this is what our community is like in 1986." Mapping is used extensively, starting with a map of the entire United Kingdom and separate maps of each of the four countries—England, Scotland, Wales, and Northern Ireland—that make up the U.K. These in turn are broken down into regions each 30 by 40 kilometers, with detailed maps. The disk also includes floor plans of many buildings.

This ambitious project, the ultimate in time capsules, is scheduled to be finished before the end of 1986. It will be of great interest to sociologists, folklorists, historians, and the curious, and its value will grow with each passing year. It also has immediate value to the CD-ROM industry and its potential customers, however, for it will demonstrate the full potential of the CD-ROM to provide integrated information in many forms. Someday Grolier's *Electronic Encyclopedia*, for instance, may provide a sample of music as well as text under "Beethoven," a scene from *Casablanca* under "Bogart," a narrated visual tour of Notre Dame under "Gothic Cathedral." Ultimately, it is this combination of video and audio along with textual information that will make the CD-ROM a new publishing medium of unique and exciting value.

—G. Berton Latamore

G. Berton Latamore is a free-lance writer and editor of VideoPrint, an electronic publishing market newsletter.

storage system for the corporate mainframe or \$40,000 or so for a PC-based system, including scanner and write-once drive, from LaserData of Lowell, Massachusetts.

OBSTACLES Sounds great: Go to your nearest computer dealer, buy a CD-ROM drive for a couple of hundred dollars, open up your PC and install it beside the existing drives, and you're in the market for all those terrific CD-ROM information products. And in a year or so, it will be that simple; unfortunately, for now it's not.

It's not that the drives aren't there. They're available, and they're manufactured by big, reliable companies. Sony and Philips invented CD-ROM, and both can sell you a drive for your PC. For \$1,000, Hitachi will sell you an external drive shaped much like an audio CD player or one that fits into a full-height disk drive slot inside your PC for a little less. Digital Equipment, Denon, Sanyo, and a number of other manufacturers are either already offering drives or have announced their intention to do so. They are all priced about the same, but, with audio CD players selling for as little as \$100 in New York electronics discount outlets, industry observers see prices of computer-peripheral CD-ROM drives dropping to \$200 or so in the next couple of years.

And while there may not yet be information products that interest you, the information industry is diligently trying to change that. There are at least 50 CD-ROM products available for general sale already, and many more are in use by large organizations. (See sidebar "CD-ROM Applications.")

The problem right now is the lack of industrywide agreement on the relationship between the computer, the CD-ROM drive, and the disks and the data on them. The physical layout of data on the disk and the error-checking and decoding schemes used by the drives are all borrowed from audio CD. But there is not yet any agreement on the way in which the data is organized on the disk, or on the interface between the CD and the rest of the microcomputer world.

The result of this lack of agreement is a jumble of competing, nonstandard ways of organizing data on disks, accessing files,

and conversing with the drive to get what is necessary. DOS knows nothing about CD-ROM, and so every developer of hardware and software has to reinvent all the conventions and interfaces. The situation is now so bad that some CD-ROM disks can be run using only particular manufacturers' drives. No interface between existing, non-CD microcomputer applications and CD-ROM is possible except by using conventions and software invented by that CD-ROM developer. This means a lot of extra work for developers and a lot of inconvenience for customers.

SETTING STANDARDS The CD-ROM industry has known for some time that this lack of standards was a problem. Back in September 1985, John Einberger, the director of software products for Reference Technology (a Boulder, Colorado, CD-ROM development company), decided something ought to be done about it. He and some colleagues contacted every company they knew that might have an interest in CD-ROM data format standards and convened a meeting at Del Webb's High Sierra Casino and Hotel in Lake Tahoe, Nevada. Despite only 10 days' notice, they all came: the subject was vital. The lofty-sounding High Sierra group, chaired by Einberger, was the result of that meeting. Its members represented the likes of Digital Equipment, Hitachi, Philips, 3-M, Apple, AT&T, Xebec, and Microsoft. In its final report, released last June, the group unanimously recommended a logical file structure that reflected the constraints and strengths of the CD-ROM medium, including a subdirectory structure that minimizes the number of slow, long-distance, random seeks across the surface of the disk. (See sidebar "The CD Format: Huge Data Density, Slow Seek Time.") The group's proposal is now working its way through official standards organizations (NISO in the United States and ECMA in Europe) and should have formal blessing by mid-1987.

In the meantime, the ball is in Microsoft's court, since the agreement on a logical data layout shifts the focus to operating-system-level standardization. Truly easy use and interchange of CD-ROM disks between different computers will require changes in DOS (and other comput-

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First, it installs so easily. It is a half slot card, only five inches in length. You don't even have to give up a full slot. What's more, unlike competing products it works in the Compaq and most clones. The instructions are so simple we considered showing a picture of a child putting it in. Easy diagrams show how you just place the card in an open slot, remove the original processor and connect a single cable. There is no software required. From that moment you are running faster than an AT.

Second, it is advanced. The **BREAKTHRU 286** replaces the CPU of the PC or XT with an 80286 microprocessor that

is faster than the one found in the AT. A 16K cache memory provides zero-wait-access to the most recently used code and data. In benchmark tests the card accelerated software programs—both custom and off-the-shelf anywhere from 200% to as much as 700%. Wow!

Third, you have full compatibility. All existing system RAM, hardware, and peripheral cards can be used without software modification. It operates with LAN and mainframe communication products and conforms to the Lotus/Intel/Microsoft Expanded Memory Specification (EMS). Software compatibility is virtually universal.

Fourth, it is the best there is. There are several other boards on the market. Some are priced about the same as the **BREAKTHRU 286** and some are cheaper. We at PCSG have compared them all, but there simply was no comparison. What we discovered is that many cards being sold offer only a marginal speed up in spite of their claims. We found some to be merely versions of the obsolete 8088 or 8086, and others to be just poorly engineered. The 8MHz **BREAKTHRU 286** is unequivocally the best executed and most completely reliable speedup board manufactured today.

PCSG has since early 1983 dominated the lap portable market with IBM software such as Lucid spreadsheet and Write ROM that reviewers rated as excellent. We were proud to successfully enter the IBM PC market last year with disk access speedup software. Now we are so pleased with the **BREAKTHRU** speedup card. We use them on our own PC's to make them faster than AT's. We are really excited about this product.

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PCSG

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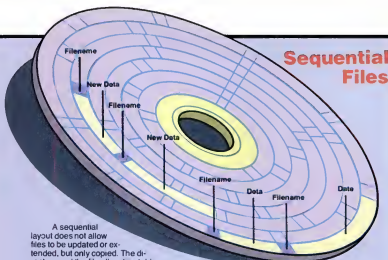
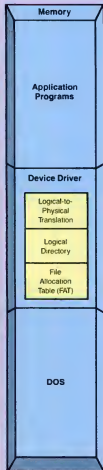
11035 Harry Hines Blvd. #207 • Dallas, Texas 75229

214-351-0564





Storing Data on a WORM



Sequential Files

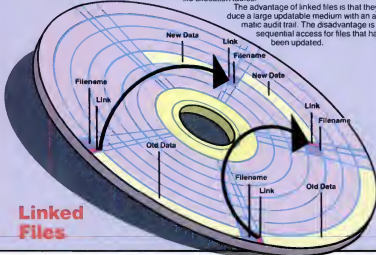
A sequential layout does not allow files to be updated or extended, but only copied. The directory and the file allocation table normally found on a disk are simulated in memory as part of the driver. This information is passed to DOS as necessary. The simulated disk information (which is created in memory) is identical to the layout of sequential files; however, the way information is obtained for the logical-to-physical translation table is different.

The logical-to-physical translation table is used to convert the logical DOS access information to the physical track and sector references on the laser disk. This conversion is performed for every read or write access. This approach allows any set of files on the WORM to be placed in the simulated disk. The sequential nature of the physical disk format lends itself to fast access.

The linked-layout WORM allows files to be updated on a block basis. It also keeps a record of what has been updated by block. The simulated disk information (which is created in memory) is identical to the layout of sequential files; however, the way information is obtained for the logical-to-physical translation table is different.

A file is initially written as a sequential file with one exception: each block has an additional link, which is zero. This link can be changed because zeros in the laser medium can be overwritten. If information has been updated, this link is changed from the old block number to the new block number. The WORM disk driver is smart enough to know that the logical-to-physical translation table must be updated and that these links should be followed when building up the initial directory and file allocation tables.

The advantage of linked files is that they produce a large updatable medium with an automatic audit trail. The disadvantage is slow sequential access for files that have been updated.



Linked Files

CD-ROM APPLICATIONS

The companies and developers listed below are the best sources of information on currently available CD-ROM applications, including up-to-date price information.

A-V ONLINE

Access Innovations
4314 Mesa Grande S.E.
Albuquerque, NM 87108
(505) 265-3991
James C. Johnstone

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PsychLit

American Psychological Assn.
1200 17th St. S.W.
Washington, DC 20036
(202) 955-7600
Lois Grinnick

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UK Library Database

The British Library
Great Russell St.
London WC1
England
(01) 636-1544

CIRCLE 668 ON READER SERVICE CARD

LePat: Local Public Access Catalog

Brodat Corp.
500 Arch St.
Williamsport, PA 17701
(717) 326-2461

CIRCLE 669 ON READER SERVICE CARD

Isocrates (Thesaurus Linguae Graecae)

Brown University
Classics Department
Providence, RI
(401) 863-2123
Ellie Mylins

CIRCLE 670 ON READER SERVICE CARD

Compact Cambridge

Cambridge Scientific Abstracts
5161 River Rd.
Bethesda, MD 20816
(301) 951-1400

CIRCLE 671 ON READER SERVICE CARD

Health and Safety in Chemistry

Chemical Abstracts
P.O. Box 3012
Columbus, OH 43210
(614) 421-3600
Brian Carman

CIRCLE 672 ON READER SERVICE CARD

Dot/Time Library System

Dotnet Corp.
818 N.W. 63rd St.
Oklahoma City, OK 73116
(405) 843-7323

CIRCLE 673 ON READER SERVICE CARD

Compact Disclosure

Disclosure
5161 River Rd.
Bethesda, MD 20816
(301) 951-1300
Hollis Palmer

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Bradstreet
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Mountain Lakes Corporate Center 2
Mountain Lakes, NJ 07046
(201) 455-0900
Robert Dipmans

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EMBASE—Excerpta Medica

Elsevier Science Publishers
32 Vanderbilt Ave.
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(800) 457-3633
(212) 370-5520
Elaine Allgood

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COMPENDEX: Aerospace

Engineering
COMPENDEX: Chemical
Engineering
COMPENDEX: Electrical and
Computer Engineering
Engineering Information Inc.
345 E. 47th St.
New York, NY 10017
(800) 221-1044
(212) 705-7600
James Buckley

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Periodical Cataloging Database

The F. W. Faxon Co.
15 Southwest Park
Westwood, MA 02090
(617) 329-3350
Cathy Kleish

CIRCLE 678 ON READER SERVICE CARD

LaserQuest: GRCCOM Resource

Databases
General Research Corp.
3383 Hollister Ave.
P.O. Box 6770
Santa Barbara, CA 93111
(805) 964-7724

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ers' operating systems as well). Microsoft's Carl Stork, director of marketing for the CD-ROM division, isn't ready to announce anything yet but acknowledges that it is working on a CD-related upgrade to DOS.

During High Sierra's work, Philips and Sony threw in a monkey wrench by announcing plans for a new standard of their own called CD-I (for interactive). The CD-I standard will organize CD disks containing different kinds of information—combinations of text, graphics, sound, and software—and is aimed at the mass consumer market rather than at computer users. CD-I includes specifications for the kind of hardware needed to use the disks (a 68000-based microcomputer contained in a CD player shell) and the interconnections to the display and audio worlds. A CD-I

system will be "plug and play" like a video game machine rather than a flexible, general-purpose, somewhat more complex tool like a microcomputer.

It's not at all clear what kinds of products will be created using the CD-I standard—the only existing products that come close to using video, audio, text, and software are video games—but it is clear that the CD-I evolution will have no effect on the development speed of CD-ROM products and standards. According to representatives of Philips and Sony and High Sierra's Einberger, CD-ROM and CD-I are compatible standards. High Sierra managed to accommodate the needs of CD-I in its proposals without compromising the usefulness of CD-ROM in its primary market—delivery of professional and business information.

DATABASE ORGANIZATION Beyond data organization and operating systems, there's another level in which we, the consumers, would be well served by some consistency: database and software organization. All current CD-ROM products include not only data but the software with which to interact with the data. The software, of course, includes the user interface—the commands, the searching method, the display screens. So if you want to use one company's corporate information database in the morning and another's encyclopedia in the afternoon, your interactions with the two databases will be completely different. What's needed is some standards for database organization that let the developers of search-and-manipulation software anticipate how the data is going to be organized, let data distributors off the

The Electronic Encyclopedia

Grollier Electronic Publishing
95 Madison Ave., #407
New York, NY 10016
(212) 696-9750
John Croll

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Three legal and two internal
databases

Harwell Laboratories
Abingdon
OXONOX11
England
(02) 352-4141

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Demonstration disk

Hitachi Corp.
1290 Wall St.
W. Lyndhurst, NJ 07071
(201) 825-8000
Mr. Morishima

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Catalogers Tool Kit**

Horizon Information Services
1900 S. Sepulveda Blvd.
Los Angeles, CA 90025
(213) 479-4966

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950 University Ave.
Bronx, NY 10452
(212) 588-8400

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Nashville, TN 37217
(615) 793-5000
Angela Schaad

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and Technology and Dictionary of
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New York, NY 10020
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The Michie Co.
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Charlottesville, VA 22906
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Universe of Sound, Vol. 1

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(408) 662-1772

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CUJE & RIE '80 to present
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(212) 736-6629

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R.R. Bowker
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New York, NY 10017
(212) 764-5121

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Royal Society of Chemistry
Burlington House
Piccadilly, London W1
England
(01) 734-9971

CIRCLE 670 ON READER SERVICE CARD

PC CompuStat

Standard & Poor's
1221 Ave. of the Americas
New York, NY 10020
(212) 512-4900

CIRCLE 669 ON READER SERVICE CARD

1984 IEEE Journals & INSPEC

University Microfilms International
300 N. Zeeb Rd.
Ann Arbor, MI 48106
(313) 761-4700

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USGS Database Demonstration

Disc
U.S. Geological Survey
12-201 Sunrise Valley Dr.
Reston, VA 22091
(703) 648-7126
Jerry McPaul

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LAWMARC**

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Woodside, NY 11377
(718) 672-1400

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software-development hook, and let users learn one system for all data.

Such a standard "would be nice," says Julie Schwerin, president of InfoTech (a consulting and product development firm in Pittsfield, Vermont) and a widely read commentator on the CD-ROM industry. But she doesn't think it's going to happen. In part it won't happen because there are good reasons for using different kinds of interfaces for different databases, and it wouldn't be in the users' interests to standardize too much. In part, though, it won't happen for commercial and marketing reasons. Companies that have data for sale don't necessarily want to be in the business of simply selling data; they'd like to capture customer loyalties in ways that data can't and user interfaces can. So if you hold out until standards are developed at

the applications level, you're likely to miss the whole CD-ROM game.

The strengths of CD-ROM are the enormous amount of data it can hold and the economies that are possible because it has so much in common with the mass-production audio disk. The cost of creating a master CD, from which a huge number of copies can be pressed, is on the order of \$10,000 and dropping; the cost of pressing the disks themselves ranges from \$50 apiece for tiny quantities down to little more than \$5 if you want several thousand. There are several plants already in place that can handle the pressing and many consulting companies that will help you organize your data for CD-ROM reproduction, if you want a piece of this action. And the industry is barely off the ground.

CD-ROM's weakness is that, for the

foreseeable future, the time required to locate random chunks of information on a disk is enormously greater than computer users are accustomed to with their hard disks—more comparable to the speed of a floppy disk, in fact. The problem can be alleviated to some extent by very careful layout of the disk to minimize the number of occasions that a random seek will be necessary, but the gap can't be closed. And the unusual constant-linear-velocity drive mechanism, with its variable speed of rotation, guarantees that the CD-ROM drive you buy for your computer will never be of any use for anything but reading your purchased CDs.

THE WORM ALTERNATIVE Write-once, read-mostly (WORM) optical disks and drives are also a reality. Drive produc-

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ers include major companies like Sony (again) and Toshiba; a number of subsidiaries or joint ventures of big companies, such as Optical Storage International (Philips and Control Data) and Optimem (Xerox); and several small independent companies like Laserdrive, Information Storage, Optotech, and Lancore Technologies. All their 5¼-inch drives cost in the \$4,000 to \$5,000 range, and the current price of a 5¼-inch disk cartridge is on the order of \$90 to \$100. Some of the companies produce other sizes of drives (often

12-inch), but they are fast fading in favor of the 5¼-inch standard, and 3½-inch optical media are coming up on the horizon.

Current data densities on the 5¼-inch drives are between 100 and 200 megabytes per side, although 300 to 400 megabytes should be possible within a couple of years. Current drives play one side of a single disk at a time, but double-headed drives for two-sided disks, "jukebox" disk changers, and multispeed drives that can handle several disks simultaneously are not far off.

Most of the current sales of write-once optical drives are for narrow applications, in which the drive is part of a packaged solution for a particular market. Consequently, the interchangeability of data from one make of drive to another is not usually required. Good thing: you can't even get an Optotech cartridge into the slot in the front of an Information Storage drive, much less make sense of the information on it.

There are efforts to create standards in the write-once arena. An American National Standards Institute committee is

THE CD FORMAT: HUGE DATA DENSITY, SLOW SEEK TIME

Because the CD-ROM's motor must change speeds as it changes tracks, information on the disk must be very carefully organized to limit track changes and make access times reasonable.

A CD carries a single spiral track that starts at the center of the disk and works its way outward. The turns in the spiral are microscopically close together—16,000 of them per inch of radius, compared with only a couple of hundred on a hard disk. The flat surface of the disk is called "land." Tiny grooves (called "pits") are physically sunk into the land during the disk-pressing process, much like a phonograph record but with far higher precision. The groove pattern represents zero and one bits but has a complex coding scheme that uses nearly four bits for every one of real, usable data. The extra bits are used for speed control and for sophisticated error correction. If a small area of the disk is obscured by scratches or suffers from a manufacturing defect, the data on it can be reconstructed with the redundant information in the extra bits.

The track is divided into sectors that contain (usually) 2K bytes of real data, plus about 300 real bytes of additional error correction, synchronization, and address information. Each 2K block is exactly the same length along the track—about ¾ inch—no matter whether it is close to the center of the spiral or far out toward the edge. It follows that

the loops of the spiral out at the edge, being longer, contain more sectors of data than the loops near the middle.

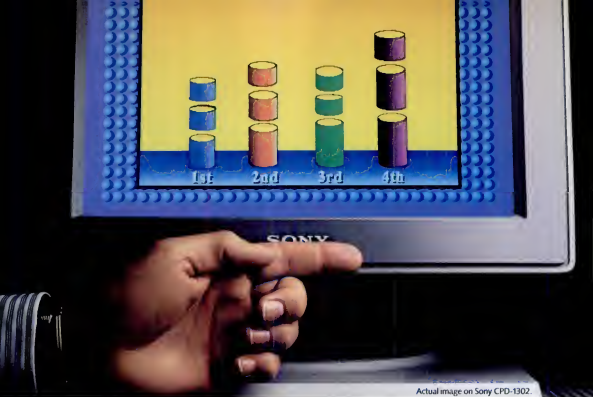
When an audio CD is playing music, the laser in its drive starts reading the data at the center of the disk. It swallows 75 sectors (or over 150K bytes) per second and converts them at that rate into analog electrical signals that it feeds to your stereo amplifier. The laser is mounted on a reading head that moves radially outward from the disk's center, and the disk spins under it, allowing the laser to follow the spiral. To maintain the 75-sectors-per-second rate as the loops of the spiral get longer, the motor that is spinning the disk under the laser must speed up gradually as the head moves outward.

This recording scheme is called constant linear velocity (CLV), since the speed of the scan is constant along the line of the spiral. The alternative scheme, used by nearly every other computer disk in the world, is called constant angular velocity (CAV). A CAV drive rotates the medium at a constant rate, and the same amount of data is stored around each concentric track on the disk. Consequently, the longer outer tracks are not very densely packed with data and a lot of capacity is wasted.

A SECOND'S WAIT CLV makes a lot of sense for audio CD, since most of what the drive does is simply follow a track and pour out a stream of data at a constant rate. Only occasionally, when you decide you want your CD player to skip from track 4 to track 6 of your favorite Tina Turner disk, does the drive have to move the head out along the radius and speed up the disk to match. In the audio world, with its looser tolerances, the second or so this process can take is acceptable. But a second's wait to fetch the next block of data in a database is not, and therein lies the need for a lot of planning and scheming to make CD-ROM an acceptably fast data storage and retrieval mechanism.

Great efforts need to be made to figure out the sequence in which data will be required, so one block can be located as near as possible to the next. Files should be kept contiguous. The index structure mustn't demand three or four movements to locate a piece of data. Unfortunately, not all these criteria can be met for all circumstances. Fortunately, because the data once organized and pressed will never be changed, great care and planning can go into the layout of each disk.

—John Hellmuth



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working on reaching a consensus on matters ranging from the physical characteristics of the cartridges through the optical characteristics and format (analogous to the Sony/Philips physical standards for CD-ROM). Ultimately, it would like to settle on a logical file structure standard comparable to that of the High Sierra group. The process in the write-once arena is different—it is being carried out through official standards bodies rather than imposed by a couple of giant corporations and licensed to everyone else—but the result should be the same: media interchangeability among different manufacturers' devices. (Ed Rothchild, San Francisco-based publisher of *Optical Memory News*, thinks there may be some stalling in this area, however. He suspects that the American drive manufacturers are reluctant to see drives standardized to the extent that low-cost, high-volume overseas manufacturers have the chance to dominate the emerging market.)

The result of this current situation is that you are unlikely to find a reason to buy a write-once drive by itself; it will show up on your desk only if it is part of a larger vertical-market system.

ERASABLE MEDIA Standardization may not be critical in today's specialized write-once market, but it will be once the next wave hits: erasable optical media. Already, according to Rothchild, erasable 5 1/4-inch optical media and drives are being beta-tested at numerous sites in the United States, and he expects that the first "multifunction" drives will be announced by next spring. Multifunction drives could write onto write-once or erasable optical media. They could read both of these types, as well as read factory-pressed read-only media (but not standard CD-ROMs).

While write-once optical media have their own special advantages in applications where an indelible medium is desirable, the erasable medium, in Rothchild's opinion, promises to give our familiar magnetic media a very firm shove off center stage by the mid-nineties. The erasable and write-once systems in use and planned do not suffer from the access-speed problems inherent in CD-ROM's use of constant-linear-velocity recording; they store data in concentric tracks much like current

magnetic media. And the disks themselves promise to be at least as durable as existing magnetic media.

So, at the end of the road, revolutionary optical disk technology becomes simply a replacement (with vastly greater capacity, to be sure) for our current magnetic technology.

But with a twist: optical technology will remain a better distribution medium than magnetic media because optical disks can be stamped out, thump-thump, like cookies in factories, while magnetic disks still have to be duplicated byte by byte and track by track.

WHAT'S NEXT And with that, this tale of three technologies comes full circle: there's already a replacement for CD-ROM (before it's even really taken off) on the horizon. CD-ROM capabilities are never likely to be integrated into the multifunction devices designed for 5 1/4-inch erasable and write-once disks; the mechanisms are just too dissimilar, and a combination device would just be two devices married, uncomfortably, in one box. Better to have two separate devices.

But that doesn't preclude 5 1/4-inch, factory-stamped read-only disks; they just wouldn't be CD-ROMs. Indeed, a number of companies have proposed such a creature—OROM is 3M's name for it. DataROM is favored by Sony. They would share the physical and logical characteristics of the write-once and erasable media but would be used for CD-ROM-like information distribution chores. Evolution of these disks will depend on market acceptance of the CD-ROM, and the rate at which write-once and erasable media standardize and penetrate the market.

Optical data storage is in your future. You're going to be tempted by exciting CD-ROM information products and cheap drives within the next year, and in many markets, systems based on write-once optical technology will be competing for your dollar. Standards issues will darken the industry for a couple of years yet, but, of course, with a technology built on lasers, there's no doubt that there's light at the end of that tunnel. □

John Helliwell is a Toronto-based writer and microcomputer consultant.

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Grand Rapids, MI 49507
616/243-1312

Archive Systems, Inc.
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Boca Raton, FL 33431
305/393-4602

Corporate Micros, Inc.
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New York, NY 10019
212/315-2853

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Birmingham, AL 35295
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502/580-0301

ICS Software
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Brooklyn, NY 11235
718/743-4050

INACOMP Computer Centers
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305/236-8966

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205/988-5111

Don Sivilz & Associates
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Cincinnati, OH 45214
513/421-1105

Southeastern Systems, Inc.
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Gastonia, NC 28054
704/866-9048

TENMAST Software Systems
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Lexington, KY 40502
606/268-0995

TRIMAPC Systems, Inc.
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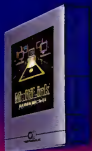
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CIRCLE 162 ON READER SERVICE CARD

1-2-3 KNOCKOFFS:

■ ■ ■
HOW CLOSE
DO THEY
COME
?

Three low-cost imitators, VP-Planner, The Twin, and Farsight, can run 1-2-3 macros and offer some added functionality. But can you buy true Lotus performance for one-third the price?

If you're in the market for a program that looks, acts, and feels exactly like 1-2-3, Release 1A, you're out of luck. Lotus won't sell you the original anymore, and none of the imitators has produced an identical copy. This doesn't mean you're stuck with Release 2.0 of 1-2-3, though. Some of the imitations are pretty close. If you're new to spreadsheets, a low-priced 1-2-3 knockoff may be just what you need.

If you already use 1-2-3, Release 1A, in your office and just want to add more "copies," don't forget that all three of the programs reviewed here—*Farsight*, *The Twin*, and *VP-Planner*—have added some functions to your current standard. They may be able to run almost any 1-2-3 macro you write, but models you build with their original functions won't run properly with 1-2-3. You won't get full, two-way compatibility.

Something else to think about is memory. All three imitations use more of it than 1-2-3 does, and so big models that run on 1-2-3 may not fit. On my machine, a 159K-byte file filled 1-2-3 to the brim, but *VP-Planner* could swallow only 80K of it. The other two programs could handle even less.

If memory isn't a problem for you,

there are two more issues to consider: degree of compatibility and usefulness of the additional functions. Price is *not* an issue, since all three programs are priced within a dollar of one another.

VP-Planner

Adam Osborne, the man who rode to fame and failure with the Osborne computer, has come roaring back with Paperback Software. *VP-Planner* is the best known and the most expensive of this low-cost series. A lot more than a 1-2-3 knockoff, *VP-P* puts real power at your fingertips. One of its highly touted features may be almost too complicated to use, but *VP-P* is a good product that deserves to do well.

As a spreadsheet, *VP-P* is about as close to a perfect copy of 1-2-3, Release 1A, as you're likely to find. Every template and macro I tried on it worked perfectly, though the manual warns that some offbeat 1-2-3 coding may throw the program off. For example, *VP-P* can't handle 1-2-3 range names that begin or end with a space, and it will behave strangely if you run macros that make menu selections by moving the cursor and hitting Enter. These are obscure incompatibilities, though, and

■ 1-2-3 KNOCKOFFS

unless widespread use smokes out some serious bugs, you can consider *VP-P* pretty close to compatible.

The *VP-P* spreadsheet has additional features that prevent two-way compatibility. It has more date and currency formats, which allow displays like DM 23 734.00 or 12/25/86. *VP-P* also lets you set spreadsheet column widths to 0 and set widths by ranges of columns as well as one by one.

Other improvements over 1-2-3, Release 1A, include sparse-matrix memory management, a command that lists named ranges, and a built-in spooler that lets you print one spreadsheet while you work on another. The graphics are no better than 1-2-3's, but you can print them without running a separate "print graph" program—a boon to floppy disk users.

VP-P comes with a little more macro power, too. The command */XW* lets you build pauses into macros of from 0 to 65,535 seconds. A {GoRef} key word acts as a relative "goto"; that is, it specifies the column letter and row number of a destination cell by the contents of two other cells. This key word allows you to update macro operations on the fly. *VP-P* also comes with Autokey, a macro learn mode that turns keystrokes into macros. It uses a slick system to let you write */X* commands this way too and politely prompts you for their necessary components.

For color users, *VP-P* lets you change the background and foreground tones through a simple slash command. It's a

	U	V	X	Y	Z	AA
14	N	(goto)ABS"			Go to bottom of worksheet	
15		/!147125"			Import directory file	
16		(goto)COUNTER"count(ABS..a201)-4"			Count files	
17		(edit)(calc)"			Make number absolute	
18	TEST	/!COUNTER="8"/!XQUIT"			Test counter	
19		/!COUNTER"SPACE"			Copy counter value to SP	
20		(goto)SPACE"(edit)(home)"			Make SPACE a label	
21		(goto)DATA"			Go to DATA (location for	
22		/!canDATA"off"			Combine file from disk	
23	SPACE	5			Space for last character	
24					Carriage return to end C	
25		(goto)COUNTER"			Go to COUNTER	
26		(edit)-1"(edit)(calc)"			Reduce COUNTER by one	
27		/!XTEST"			Loop back to TEST	
28						
29						
30		QUIT	/!ABS..a101"		Erase imported directory	
31		(home)			Go to A1	
32		/!XCONSOL"			Save consolidation data	
33		CONSOL"r(sec)			Range to save is CONSOL	
W31		(home)				
<div> <div>Help</div> <div>Edit</div> <div>Name</div> <div>Cells</div> <div>Goto</div> <div>Window</div> <div>Data</div> <div>Table</div> <div>Calculate</div> <div>Graph</div> </div>						WINDOW
83K 12:13						

VP-Planner is as close to a perfect copy of 1-2-3 as any low-cost spreadsheet can be. This screen shows the worksheet layout. It differs from 1-2-3 in that the command lines are at the bottom of the screen rather than at the top, and commands can be selected and activated by function keys. Unlike its competition, *VP-Planner* has the capability to process "multidimensional" spreadsheets, but as you can see, setting up the logic statements may be tricky.

welcome relief from 1-2-3's boring color scheme, and it has a striking use in macros: If the macro calculation produces an unexpected result, you can turn the screen red.

VP-P's big claim to superiority over 1-2-3 is its database. Sure enough, you can read, write, create, and update *DBASE II* or *III* files from within the worksheet. You can read a whole file or just parts of it according to simple mathematical sorts. You can join the contents of files, as long as they have a common field. Once you have the data inside *VP-P*, you can do anything you like with it, and the whole operation can be run with macros.

This *DBASE* link is a significant extension of 1-2-3, especially for anyone who is up against the 640K memory limit. Heavy users often run out of memory, not because they have huge models but because 1-2-3 has to keep entire databases in memory. *VP-P* lets you use only the part you need right now and leave the rest on disk.

The other highly touted *VP-P* feature is "multidimensional databases," which use the same data to make new reports and consolidations. The theory is fine: track data along up to five "dimensions." For example, if you have ten products and chart their sales over time, a spreadsheet would list products down the left and

months across the top. If you wanted the same information by sales region, say, you'd have to build more spreadsheets. To get total figures, you'd have to consolidate, which can be messy.

VP-P does all this for you. Once you've set up dimensions, categories, and logic statements, *VP-P* does the sorting and arithmetic and will produce many different reports with the same data. The catch is, setting all this up is fiendishly tricky. The 100 or so pages of the manual on multidimensional databases are rough going.

If you're really desperate to consolidate, buy a real three-dimensional spreadsheet like *Report Manager* or *microCUBE*, but don't let this unwieldy feature scare you away from *VP-P*.

The Twin

The *Twin*, like *VP-Planner*, is a cut-rate 1-2-3, Release 1A, knockoff with something more—in this case better graphics. There are distinct limits to its compatibility, but most of what you can also do with 1-2-3, Release 1A, you can do with *The Twin*. Although the control panel is at the bottom of the screen, the spreadsheet maintains the look and feel of 1-2-3. All the familiar functions are there, and if you



FACT FILE



VP-Planner,
Version 1.21
Paperback Software
International
2830 Ninth St.,
Berkeley, CA 94710
(415) 644-2116
List Price: \$99.95; un-

protected version, \$109.95

Requires: 256K RAM, one floppy disk drive, DOS 2.0 or later.

In Short: *VP-Planner*'s spreadsheet is as close to 1-2-3, Release 1A, as you're likely to get. It adds some features and is almost fully compatible. Copy protected. Unprotected version available.

CIRCLE 64 ON READER SERVICE CARD

■ 1-2-3 KNOCKOFFS



1-2-3, Release 1A, and Imitations: Summary of Features

Product/ Manufacturer	Price	Cube-root calculations (seconds)	Addition/ subtraction (seconds)	Load-a- file (seconds)	Macro execution (seconds)	Number of windows	Number of rows	Number of columns	Copy protected	Sparse memory manage- ment	Memory used (Kbytes)	Context- sensitive help
PC VP-Planner Paperback Software International	\$99.95	18	18	26	30	6	9,999	256	Yes**	Yes	185	Yes
Farsight Interface Tech- nologies Corp.	\$99.95	22	21	38	99	2	2,048	256	No	Yes	220	Yes
The Twin Mosaic Software	\$99.00	4* 28	17* 26	18* 36	13* 13	2	8,192	256	No	No	238	Yes
1-2-3, Release 1A Lotus Develop- ment Corp.	N/A	20	15	28	11	2	2,048	256	Yes	No	99	Yes

*Using the 8087 math coprocessor. **Unprotected disk available for \$10 extra. N/A—Not Applicable (Release 2.0 currently sells for \$150).

PC—indicates Editor's Choice.

The following tests were performed on each of the products: **Cube-Root Calculations** Find the cube root of 1,003,390 times. **Addition/Subtraction** Add 664 5-digit numbers and subtract the sum from itself 25 times. **Load-a-File** Load the Cube-Root-Calculations file, which is 15K bytes long. **Macro Execution** Perform various screen manipulations and then test a column of numbers for a particular value.

know 1-2-3, you can go right to work.

Twin has added a few things to make life easier. It has a whole new set of cursor movement commands that use Ctrl-shift with number-pad keys. These take you to the right, left, top, or bottom edge of your

al "at" (@) functions. Two of the five functions calculate the value of complex cash flows, and the other three are the logical functions @and, @or, and @not. The @not function simply reverses the true/false value of an expression, while the other two are a shortcut around repeated uses of #and# and #or#. For example, the expression

@or (B17=6, H45>H46, E18<30)

will be true if any of the relations in the list are true.

8087 COPROCESSOR Of the three Lotus knockoffs, *The Twin* is the only one that can drive the 8087 coprocessor. This makes a difference, especially if your math is complex. Finally, *Twin* has an excellent utility that lets you change the screen colors for just about every part of the spreadsheet: foreground and background, menus and prompts. It's easy to use, and you get a choice of 16 colors.

On the debit side, *Twin* is something of a memory hog, and so models you can run with 1-2-3 or *VP-Planner* may not fit. Moreover, it uses memory inefficiently; one entry in the lower-right-hand corner can gobble it all.

Once, when I tried to delete part of the

spreadsheet to get a bit of memory back, I managed to lock up the program and had to reboot—never a good sign. Also, although *The Twin* successfully processes most 1-2-3 macros, it choked on a routine in a commercial 1-2-3 template and belched up an undocumented error message. Perhaps worst of all, although it can read 1-2-3 files, *The Twin* doesn't normally write files that 1-2-3 can read, even though it gives them a standard .WKS extension. To write a 1-2-3-readable file takes a separate translation step.

■ Of the three Lotus knockoffs, *The Twin* is the only one that can drive the 8087 coprocessor. This makes a difference, especially if your math is complex.

model. Since the edge is where you are most likely to be working, it's good to be able to get there in a flash. And if you want to build that capability into a macro, *Twin* gives you some new key words like {Cpgup} and {Cleft}.

The program comes with five addition-



FACT FILE



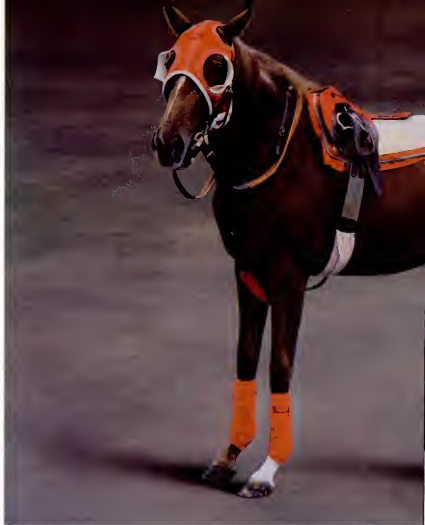
The Twin, Version 1.3
Mosaic Software Inc.
1972 Massachusetts
Ave.
Cambridge, MA 02140
(617) 491-2434
List Price: \$99
Requires: 320K RAM,

two disk drives, DOS 2.0 or later.

In Short: *The Twin's* spreadsheet has the look and feel of 1-2-3 and offers better graphics. But it falls short of true compatibility. Not copy protected.

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	Smart	1-2-3
• Virtual Memory	Yes	No
• View Multiple Spreadsheets Simultaneously	Yes	No
• Full-Screen Formula Editing	Yes	No
• Link Spreadsheets	Yes	No
• Records English Commands	Yes	No
• Designed For Multitasking (file locking)	Yes	No
• Programming Language	Yes	No
• Built-In Communications	Yes	No
• Not Copy Protected	Yes	No
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The Smart Spreadsheet

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■ 1-2-3 KNOCKOFFS

GRAPHICS *Twin's* big draw is graphics, and they're pretty good. You can put together quite presentable pie-bar charts (see screenshot of *The Twin*), 3-D charts, and charts with two y axes with different scales. For titles, you can choose from 11 different type fonts, and you can use any 3 in one graph. You can also use as many as eight data ranges instead of 1-2-3's six, and you get twice as many colors: eight instead of four. If all you need is a quick visual image rather than presentation graphics, you can knock out simple, 1-2-3-style charts in no time.

Twin doesn't have a separate "print graph" program, and so you can send your graphics to printer or plotter without delay. On the other hand, to get the whole program into memory, you have to feed in two disks' worth of program every time you load. This isn't a problem if you have everything on a hard disk, but if you're stuck with floppies, the disk switch cancels out the advantage of being able to print graphs right from the screen.

By the time you read this, Version 1.4 of *Twin* will be on sale. It will be able to

read files from 1-2-3, Release 2.0, and should have taken the macro processor a step or two closer to full 1-2-3 compatibility. The program isn't an identical twin yet, but it's getting closer.

Farsight

Farsight tries to bring you integrated software at a bargain price: a 1-2-3 imitation, a full-fledged word processor, and a windowing system to operate them under. It comes with hooks to other programs sold by the same vendor, so that you can effortlessly add functions and power whenever you need them. A good idea, but not so well executed.

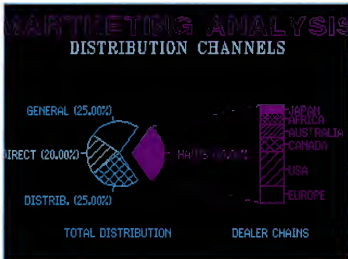
As a 1-2-3 copy, *Farsight* tested out as about as compatible as *The Twin*. It runs most macros without a hitch, but it bombed at the same place in the same commercial template as *Twin*. *Farsight* is also relatively slow, with an especially bad score on macro execution. The most glaring of its defects: it has no graphics capability at all.

The most surprising incompatibility,

though, is in the command structure. Presumably in order to keep commands the same as in the word processor, it uses the F3 key instead of the slash key to bring up the command menu. This is a quirk you can get used to, but there's worse. Once you've got the command menu, you can hit the first letter of each choice to select that command. That's just like 1-2-3. But in 1-2-3, the command then executes. In *Farsight*, all it does is highlight the menu choice. To get the command to execute, you have to hit Enter.

For example, if you want to clear titles in 1-2-3, you hit four keys: / W T C and you're done. In *Farsight*, it's F3 W T Enter C Enter—two extra keystrokes. Experienced 1-2-3 users don't even look at the menus for common slash commands.

■ *Farsight* may eventually grow up to be a fine program, but the current product feels like a beta version. Bash a few more bits, please.



The *Twin* outshines the competition when it comes to graphics. Pie-bar charts, such as the one pictured here, and 3-D charts are relatively easy to create. The *Twin* offers 11 type fonts and 8 colors from which to choose. Its screen is most like 1-2-3's; the commands will make the 1-2-3 user feel right at home. The program also offers a utility that lets the user change screen colors for every part of the spreadsheet. It's simple to use, and there are 16 available color choices.

These useless Enters will break your stride and slow you down. *Farsight* does let you set a switch from DOS that eliminates some of these Enters, but not all of them. Why not?

MATCHING SYNTAX You brainier readers are already wondering how *Farsight* runs 1-2-3 macros if its command syntax is different. Somehow, when it's processing macros, it's more 1-2-3-compatible than when it's processing keystrokes. In macros, it understands the slash character perfectly, and you can use it if you like. Or you can write macros the *Farsight* way, and use its unique keyword, {menu}, for F3 and put in tildes (~) for all those extra Returns.

In fact, you can write 1-2-3-style macros that will do things in *Farsight* that you can't do from the keyboard. For example,

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■ 1-2-3 KNOCKOFFS

the command menu doesn't include a column-width-reset command, and if you try the sequence that should work, you get nothing. But if you write the sequence into a macro that starts with a slash, column-width reset works!

Since *Farsight* doesn't do graphs, if you give it graphing commands from the keyboard, nothing happens. But when I wrote a macro that calls for a graphic display, I got a nice undocumented error message: "Function not yet implemented." *Farsight* hasn't yet implemented a worksheet status command that tells you how much memory you have left, and so if you try that sequence from the keyboard, nothing happens. But if you write a macro to try it, you get the same error message. I suppose this message means that Interface Technologies eventually plans to make a real 1-2-3 imitation. It hasn't yet. And this is a shame, because *Farsight* does some things I wish 1-2-3 did.

NEW COMMANDS *Farsight* can have more than one spreadsheet in memory and display them simultaneously in different windows. If you want to pull a chunk out of one and put in another, a few keystrokes will do it. It also has a command that lets you search for labels or values within your worksheet. This function is great when you forget where you put 1979's sales figures.

In addition to the usual scripted macros, *Farsight* also has a learn mode for recording them. These "learned" macros seem to be only in memory, though, because I

Beginning Principal	Payment Amt	Interest	Principal Amortization	Ending Balance
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FSRSC	RSC	14336	4-01-86	15:30:26
FSRUTLS	OVV	5410	4-01-86	15:30:24
FSW	SSS	0	7-17-86	15:55:09
HELPS	PWL	31560	4-01-86	15:31:05
INSTALL	OVV	31880	4-01-86	15:30:23
MONTHSAL	WKS	4978	4-01-86	15:31:18
MORTGAGE	WKS	13878	4-01-86	15:31:09
README	WRD	7838	4-01-86	15:30:03

(more)

This *Farsight* screen shows its 1-2-3 look-alike worksheet running in one window while a disk directory appears in another window below. Window capabilities are one of *Farsight*'s main advantages over 1-2-3, but its slow speed may frustrate expert users. In addition, worksheet commands require the user to hit Return after identifying the command by letter. This feature is particularly unappealing to 1-2-3 aficionados who are accustomed to flying through the commands quickly and effortlessly.

couldn't find their scripts anywhere. A peculiar and amusing feature of these learned macros is that they work throughout *Farsight*. One that you record in a spreadsheet will run in a word processing document. But surprise! The menus and commands are different in the word processor, so the macro might just run amok.

Word, as Interface calls its *Farsight* word processor, appears to be a reasonable product, but I didn't spend much time pounding it. It is an on-screen formatter that has a built-in mail-merge, and it does superscripts and subscripts, headers and footers, but not footnotes. The editor isn't as speedy as I'd like, but it does the job.

The *Farsight* windows feature is a complete DOS shell that lets you display disk directories, documents, and spreadsheets all over your screen. You can build subdirectories and manage your files with it. It's handy to be able to move numbers from a spreadsheet in one window into a document in another. But it too is a little on the slow side, and I got tired of waiting for it to do its magic.

Farsight may eventually grow up to be a fine program, but the current product feels like a beta version. Bash a few more bits, please.

PC EDITOR'S CHOICE

Of the three imitations, V-P Planner is my first choice. It pleased me to see it run every 1-2-3 model and macro I fed it. There may be some tricky templates it can't negotiate, but I didn't find any. The other two programs failed partway through a complex, professionally coded template but would very likely run anything an average user wrote.

CONCLUSION I wish you could buy a program just like 1-2-3 for one-third the price, but you can't. I suppose it would be asking too much of anyone to make a functionally identical copy of somebody else's program. Engineers can't help "improving" on anything that went before. But given the trade-off between improvements and shortcomings, I might take a second-hand copy of 1-2-3 for \$100 rather than buy an imitation.

Jared Taylor is a contributing editor at PC Magazine.

PC FACT FILE

Farsight, Version 2C
Interface Technologies Corp.
3336 Richmond, #200
Houston, TX 77098
(713) 523-8422
List Price: \$99.95
Requires: 256K RAM, two disk drives, DOS 2.0 or later.

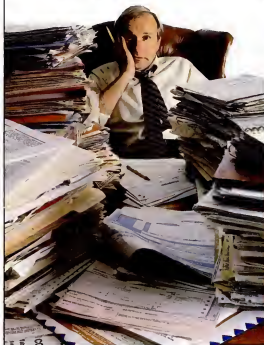
In Short: *Farsight* adds some features and functions to 1-2-3, Release 1A, but it lacks graphic capabilities and won't work with standard 1-2-3 keyboard commands. Not copy protected.

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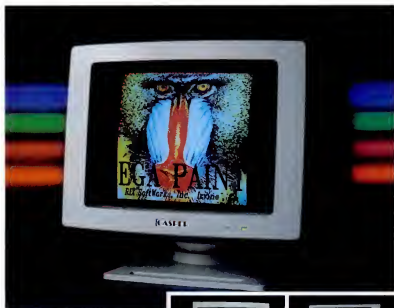
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Input

TTL signal

Base

Tilt and swivel

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High resolution

Picture

Non-glare 14" CRT

Input

TTL signal

Switch

3 color options

(RGB/amber/green)



CASPER GM-1230

Display

Monochrome

18.432 KHz

1000(h) x 350(v)

High resolution

Picture

Non-glare 12" CRT

Input

TTL signal

Dimensions/Weight

320 x 324 x 345 mm

Net wt: 7.8 kgs



CASPER GM-1000

Display

Monochrome

18.432 KHz

1000(h) x 350(v)

High resolution

Picture

Non-glare 12" CRT

Input

TTL signal

Dimensions/Weight

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NEW PLOTTERS: ALL THE WAY FROM A to E, PART I


Every year brings new PC buzzwords to the business place. And every year, one new buzzword wins the prize for pervasiveness. Last year's hands-down winner was AI, for artificial intelligence. Some applications software publishers even redesigned their product packaging to proclaim, "New! Improved! AI added!" Or at least it seems that way in retrospect.

The strongest contender for 1986 buzzword of the year is desktop publishing. Not that desktop publishing is a phony applications category; it's just that the phrase seems to mean whatever anyone wants it to mean.

As buzzwords come and go, one personal computer application—graphics—keeps enlarging its following, cutting across different levels of computing expertise as well as work environments: profes-

sional, corporate, small business, and personal. The emergence of IBM's Enhanced Graphics Adapter as a standard (see "The Enhanced Graphics Standard Comes of Age," *PC Magazine*, Volume 5 Number 14) has added more resolution and color to large numbers of PCs. Better software graphics represented by such programs as Lotus's *Freelance*, adoption of graphical user interfaces like *Microsoft Windows* and *GEM*, the emergence of page composition software for PCs—all these developments suggest that graphics is becoming intrinsic to personal computing.

In fact, graphics software is enjoying a boom. Business users are increasingly creating their own presentation graphics. Professional-quality charts once produced by expensive outside services are now routinely generated in-house on PCs. Computer-aided drafting and design



To date, PC Magazine has reviewed dozens of plotters—from handy A-size units to CAD-dedicated behemoths. The first installment of this two-part review covers desktop plotters, fast becoming an essential tool for quality business graphics.

■ NEW PLOTTERS

(CADD), formerly possible only on powerful minicomputers and mainframes, is now one of the fastest-growing personal computer software categories.

While the beauty of graphic images on a display screen can be mesmerizing, most graphics applications require tangible output that can be printed, copied, projected, or otherwise reproduced. And the plotter, one of the oldest methods of putting computer-generated graphic images on paper, still reigns supreme as the tool of choice for transferring images to hard copy.

Plotters offer a combination of attributes that account for their enduring practicality. They can produce large documents with incredible precision, in as many colors as desired, reasonably quickly, and at relatively low cost. Prices have dropped enough over the years so that even modest personal computer systems may include a plotter if high-quality graphics output is needed.

PLOTTER DESIGNS Plotters are categorized according to the size paper (referred to as *media* in plotter jargon) they accommodate. In the United States, media size is usually designated by one of five letters, A, B, C, D, and E. A is normal 8½ by 11-inch paper, B is 11 by 17, C is 17 by 22, D is 24 by 36, and E is 36 by 48 inches. In general, small, relatively portable desktop plotters accommodate either A- and B- or only A-size paper, while large, practically immovable floor-standing plotters handle sizes up to E. A- and B-size plotters are fine for business graphics, overhead transparencies, and the like, while the larger devices are intended primarily for CADD and professional architectural, engineering, and related applications.

There's usually, but not always, a reasonably direct relationship between media capability and price: E-size plotters generally cost more than plotters that can handle only smaller media.

Most plotters can be classified as one of two basic designs, according to whether the medium is moving or stationary. Flat-bed plotters, as their name implies, have a large flat surface onto which the medium is secured. The plotter's pen mechanism is mounted on an arm that moves in one direction over the surface of the medium, and, in classic Etch-A-Sketch fashion, a

pulley system moves the pen along the arm itself. This system allows the pen to reach any area of the medium, while the medium itself remains stationary.

The alternative plotter strategy is to move the medium to and fro while the pen moves along an arm in one axis. The end result is the same: as with flatbeds, the pen can reach any part of the medium.

In older plotters of this design, called

■ The plotter, one of the oldest methods of putting computer-generated graphics on paper, reigns supreme as the tool of choice for transferring images to hard copy.

drum plotters, the medium was wrapped around a drum and anchored at both ends; drum rotation moved the paper. This technique is still used on a few large plotters, but there aren't any true drum plotters available anymore that are suitable for connection to a PC.

ROLLER BEDS A variant design that anchors the paper with friction on both ends and rolls it back and forth has become dominant. On smaller units the medium moves more or less in a flat plane parallel to the desk surface, while on larger, floor-standing models, the paper flops down in front of and behind the plotter mechanism. I first coined the term "roller-bed" plotter last year to describe such units, and the terminology seems to be catching on. Several manufacturers continue to use "drum" to designate their moving-paper plotters, but in my opinion, calling a device without a drum a "drum plotter" doesn't make much sense.

Whether the medium is stationary or moving, it's essential that it remain exactly where it is supposed to be during a plot run. Flatbeds must keep the medium flat

against the bed; otherwise the pen may graze against a raised area on the medium and disfigure the output. Various techniques are used to hold media down. The simplest is masking-tape circles on the corners of the medium. While this method has been used for many years, it can lead to difficulty in flattening the medium out, and it isn't always easy to remove the tape from the finished plot without tearing. Other flatbeds with metal beds use magnetic strips positioned at the edges of the media, while still others place sticky areas within the bed.

The best technique is electrostatic attraction, which uses a charge of static electricity to attract the medium to the bed. The charge is switched on and off to attract or release the medium. While this design is more expensive than the simpler mechanical techniques, it generally offers the best results.

KEEPING A GRIP Holding the medium exactly stationary is much easier than moving it in thousandth-of-an-inch increments at high speed. In a roller-bed design, the rollers on each end of the paper usually use some form of grit-coated or heavily scored metal wheel to grasp the medium under significant pressure. Sometimes one of the wheels is hard rubber, much like the capstan on a tape recorder. Many designs actually emboss a barely visible pattern into the medium to assure that there won't be any slippage as it moves. The rollers are fixed in position on some units, while other designs let you move the rollers to accommodate different media sizes.

A few moving-paper designs use tractors (rather than pinch wheels) similar to those on printers to grasp the edge of the medium. This design works well, although special media must be used.

PENS Plotters are further categorized by the number of pens they can accommodate. All plotters draw with only one pen at a time, but multiple-pen plotters can automatically access more than one pen. They can exchange a red for a green, for example, or a wide tip for a fine tip, without your intervention. Most graphics software can be instructed to pause when the pen must be changed, so that single-pen units can produce multicolored plots, but you

KEYCHART: PLOTTER DRIVER OF CHOICE

Once again, this versatile graphics package from Canada was very handy when it came time to test and evaluate a labful of plotters.

Last December, when PC Magazine Labs evaluated 24 plotters, *KeyChart*, a business graphics program from SoftKey Software Products in Toronto, was the software selected to drive the plotters. There were several compelling reasons for this choice. Straight out of the box, *KeyChart* works with an unusual number of plotters. In addition, SoftKey had agreed to write new drivers for any plotters that *KeyChart* did not already support.

Unlike many programs that reveal flaws over time, *KeyChart* has earned greater respect. Familiarity has bred affection. *KeyChart* can generate an extensive assortment of chart types, including bar, clustered-bar, stacked-bar, horizontal-bar, line, pie, x-y, Gantt, area, scatter, and high-low-and-volume stock charts. Each axis can be scaled independently, with log-log and semilog scales as well as standard linear scales. The provisions for text-only charts are unusually flexible and useful.

PREVIEW Our favorite feature is *KeyChart*'s screen preview, which allows you to inspect your chart before it's plotted and to modify most elements right on the screen by repositioning and resizing them. Previewing now works with the IBM Enhanced Graphics Adapter (EGA)

and Hercules video adapters as well as the IBM Color/Graphics Adapter (CGA). It can save a tremendous amount of time compared to actually plotting and then discovering that you would prefer a different size or positioning.

KeyChart uses simple and logical menus to accept data and chart layout information. The new release has a clever and easy-to-use method of "grabbing" data from 1-2-3 files, which makes it an excellent adjunct to 1-2-3 if you have tired of 1-2-3's limited chart-creation capabilities. You can import copy to your chart directly from your word processor, a much easier method than manually typing the text directly into most graphics programs. *KeyChart* not only maintains a list of charts you've created, which makes them easy to select, but also allows you to enter long descriptive names for them.

FONTS We made good use of *KeyChart*'s ability to specify either the plotter's internal ROM text font or complex fonts created by the program. In addition to supporting all the plotters tested by the labs so far, *KeyChart* drives a long list of dot matrix, laser, ink jet, and thermal-transfer printers.

An optional module adds true batch processing, which means that you can

plot a series of charts with one set of instructions. Of course, to use this capability, your plotter must bring fresh media into play after each chart is plotted, usually either by using roll media or with some form of automatic-feeding mechanism.

A few manufacturers bundle *KeyChart* with their plotters, a real enhancement to those units. But *KeyChart* is easily good enough to merit consideration on its own. It retails for \$375, the printer version is priced at \$149, and the batch plotter option adds \$225. I've been quite pleased with *KeyChart* and think it can meet the needs of many serious business users. —Glenn Hart



FACT FILE

KeyChart

SoftKey Software Products Inc.
260 Richmond St. West, #404
Toronto, Ontario
Canada M5V 1W5
(416) 598-5033
List Price: \$375

In Short: A flexible business graphics program with unusual and useful features, especially relating to the use of plotters. Copy protected.

CIRCLE 688 ON READER SERVICE CARD

have to stand around and insert the appropriate pen when it's needed.

Multipen plotters generally use one of two techniques to store their pens. The simplest is merely to position the pens along one side of the plotter within reach of the pen head, each in its own stall. The alternative is a rotating, removable carousel. Each pen is positioned around the circumference of the carousel, which circles the necessary pen into position for the pen head to grab. Either method works well.

Most pens have a tendency to dry out if they're left open to the air for any period of

time. The better multipen plotters include some form of automatic pen capping (usually a rubber grommet surrounding the tip) to seal the pen tips when they're not being used. This important convenience allows you to avoid constantly capping and recapping the pens—and, of course, extends pen life.

SOFTWARE In the past, plotters were "dumb" devices, meaning that detailed instructions for every movement of the pen head had to be sent by the host computer. Now, however, almost all plotters incor-

porate a higher-level "graphics language" stored in ROM that contains instructions for drawing circles, lines, and other entities, scaling the drawing, and other capabilities. This language simplifies the job of the graphics software, which drives the plotter.

Today there are several graphics languages, though at one time it seemed that each manufacturer was intent on concocting its own language. Fortunately, in recent years, this chaotic situation has consolidated with the emergence of de facto graphics language standards that most plotter manufac-

IBM is the father.



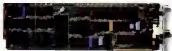
But we're the mothers who do all the work.



IDEAplus, Nov. 1982



IDEAdisk, Jan. 1983



IDEAcomm 3278, Oct. 1983



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IDEAmini, May 1984



IDEAmax 384, June 1984



IDEAcomm 5251, Dec. 1984



IDEAcomm 3270 SNA/BSC, Mar. 1985



Diskit, Oct. 1985



IDEAshare, Nov. 1985



IDEAcomm 2400, Jan. 1986



IDEAcomm 5250/Remote, Feb. 1986



Disk 2, Feb. 1986



IDEA Supermax/EMS, April 1986



All Aboard, June 1986



Overboard, July 1986

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■ NEW PLOTTERS

turers adhere to voluntarily.

The primary benefit of this trend is compatibility. A graphics program can drive any plotter that recognizes one of the standard graphics languages, even if the program's authors have never heard of a given brand. Besides the software developer, whose job is made much easier (meaning that he can create more and better software), the real beneficiary of increased standardization is you. Buying a plotter with a standard graphics language ensures that you'll be able to run a wide selection of business graphics, CAD, painting, and other programs.

The two primary graphics languages are Hewlett-Packard Graphics Language (HPGL), created by Hewlett-Packard, and Houston Instrument's Digital Microprocessor Plotter Language (DMPL). While there are lots of applications that support DMPL, HPGL is emerging as the clear leader. I've seen many programs that support both, but I've also seen quite a few that support only HPGL.

MORE PLOTTERS Last December *PC Magazine* reviewed 24 plotters, primarily desktop units (see "Adding a Touch of Color: 24 Plotters, \$399 to \$5,950," Volume 4 Number 26), and in March we evaluated two large CAD-oriented devices ("Hardware: Firm Support for CAD," Volume 5 Number 5). In this and the following issue of *PC Magazine*, we are concentrating on plotters released since our earlier reviews, including some larger CAD plotters. This issue focuses on five new A, B, and C plotters. The next issue deals with D- and E-size plotters, as well as several plotter alternatives.

PC Magazine Labs has kept the testing method the same as that for all the plotters we tested last year, so that you can compare the new machines with the ones that have been on the market longer. To make the comparison easier, we've even reprinted the PC Labs benchmark test results for the older plotters.

In one sense, plotters were one of the earliest forms of robots. They are, after all, mechanical analogs of the human hand drawing an image on paper with a pen. Perhaps this helps explain their endless fascination. Even jaded computer sophisticates gawk with pleasure as a plotter goes

through its paces. The fact that plotters produce impressive and useful results is almost icing on the cake. Even after reviewing over three dozen units, I still marvel at the precision, accuracy, and quality of these amazing and practical devices.

IBM 6180

IBM's plotter group has been offering small plotters manufactured by Hewlett-Packard for some time. PC Magazine Labs reviewed its earlier 7371 and 7372 (IBM versions of HP's 7470 and 7475A) last year. Now IBM has released its newest HP-manufactured plotter, an A-size machine it calls the IBM 6180, which is based on the Hewlett-Packard ColorPro 7440 (also reviewed in this article).

The most notable difference between

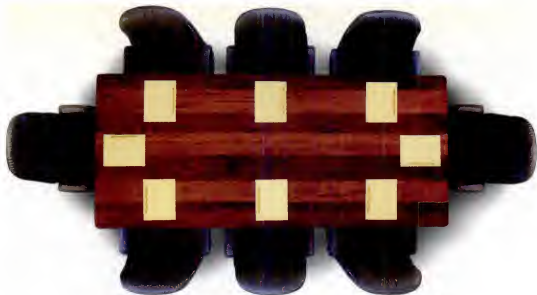
the 6180 and the IBM 7371 is the eight-pen capacity of the newer plotter compared to two pens for the older unit. While using eight different pen colors can result in a rather garish graph, the extra capacity is useful for mixing wide and narrow pens, and you don't have to stand around waiting to change pens. A rotary carousel in the HP/IBM tradition caps the pens with a rubber grommet when they're not being used. This system effectively prevents the pen tip from drying, even during extended periods. Ten colors of fiber-tip pens and seven colors of transparency pens are available, most in both .3mm and .7mm tip widths.

Instead of an internal power supply, the 6180 operates on a large external power transformer, which reduces the weight of the plotter itself. The transformer has a cord at both ends (one for connecting to the

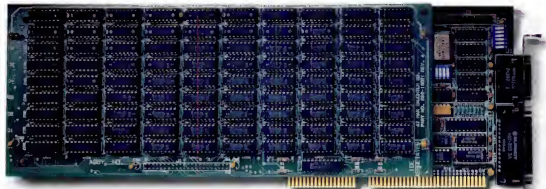


Manufactured by Hewlett-Packard and essentially identical to HP's ColorPro 7440, the IBM 6180 (A size) shares the Editor's Choice designation with that machine. Both versions consistently delivered quality output in respectable times. Like its HP twin, the 6180 is simple to use, offers HPGL compatibility, and comes with a wide pen selection and automatic pen capping.





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It took one board to create the IBM AT, but it takes another board to master it. IDEA Supermax/EMS.

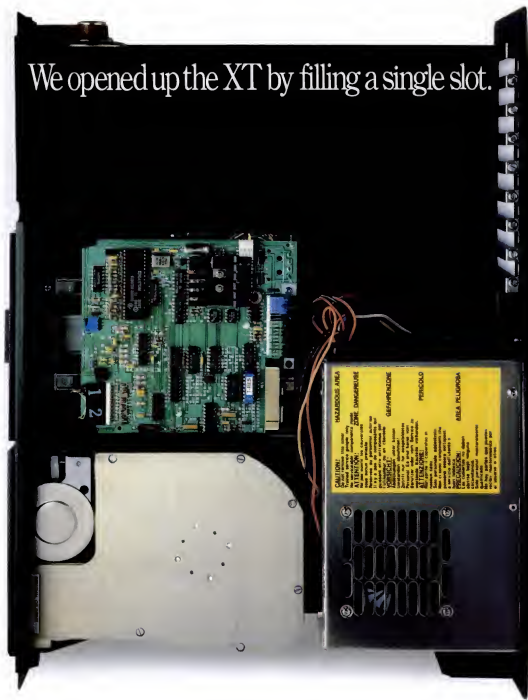
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■ NEW PLOTTERS


FACT FILE

IBM 6180
 IBM Corp.
 Neighborhood Rd.
 Department 30L-948
 Kingston, NY 12401
 (914) 385-5151
List Price: \$1,285
In Short: Fine plots and good overall performance from this A-size plotter.
CIRCLE 664 ON READER SERVICE CARD

plotter and the other for connecting to the wall outlet), so that you don't have to plug the actual transformer into the wall socket (sometimes impossible with power strips and the like).

The 12-button control panel is labeled with icons rather than words. This may make it easier for IBM to stock one model for international sales, but it also means that you have to learn and remember the meanings of yet one more set of pictures. The panel looks good and works well, but I prefer English designations.

An optional Graphics Enhancement Cartridge (\$150) plugs into the bottom of the plotter. The cartridge expands the input buffer from a paltry 60 to 1K bytes, improves area fills, and adds 14 new commands and more character sets. An interface test is supplied on disk, which is an excellent idea, especially to test interface handshaking on a complete plot to avoid overflow. Two interface shorting-test plugs are also supplied for advanced diagnostics. You can choose either RS-232 serial or IEEE interfaces, but not parallel.

Using the 6180 could hardly be simpler. Paper loading is the more-or-less standard HP/IBM method—which is to say, it relies on a pinch-roller mechanism, but the pinch wheels are now lowered and raised with a panel button rather than manually. This design feels a little more professional.

The test plots ran without incident. Obviously, the 6180 had no problem running HPGL plots. (IBM insists on calling its plotter language IBM-GL, which, despite IBM's silence on the subject, is the same as HPGL.) Plot time was in the same range as plot times for HP/IBM models tested

previously by *PC Magazine*, meaning that it was neither the fastest nor the slowest tested. The internal ROM font was attractive and would be acceptable in many business situations. Plot quality was very good, but a shade less than perfect.

The 6180 and its HP counterpart are a bit on the pricey side for an A-size plotter, given the many competitive B-size plotters for the same money or even less. On the other hand, many business users don't need anything larger than 8½ by 11 plots, and the 6180 offers more pen capacity, HPGL compatibility, very good plot quality, a smaller footprint, and the persistently appealing (to many business users) IBM name.

On the other hand, IBM plotters may be a bit hard to find. Some IBM execs don't even realize that IBM sells plotters.

Hewlett-Packard ColorPro 7440

Hewlett-Packard is the unquestioned sales and standards leader in desktop plotters. HP's 7470 two-pen A-size and 7475A six-pen A/B-size, while not the fastest units around, produce superb plots, and the 7550 eight-pen is one of the most desirable small plotters available. The latter tested very well in the last *PC Magazine* Labs plotter roundup.

HP recently replaced its 7470 with an improved eight-pen A-size model designated the 7440 but commonly called the ColorPro. It's a completely redesigned device that offers the traditional HP virtues with some new wrinkles. It is virtually identical to the IBM 6180 (reviewed in this

article), except for a few cosmetic differences (the buttons on the control panel are brown; on the IBM, they're black) and a different corporate name (Hewlett-Packard) on the ROM. Both the IBM version and the HP version are manufactured by Hewlett-Packard.

Like the other HP desktop plotters, the ColorPro 7440 uses a solidly built rotating carousel with automatic capping to keep the pens from drying out. The HP capping system is excellent; I've left pens in these plotters for weeks on end with no deleterious effects. The eight-pen capacity can be very helpful when you want to mix wide

■ Like the other HP desktop plotters, the ColorPro 7440 uses a solidly built rotating carousel with automatic capping to keep the pens from drying out.

and standard pens (.7mm and .3mm); the wider tips improve area fill and are useful for bolder headings. The pens are interchangeable with standard HP pens used in Hewlett-Packard desktop plotters. They are notably excellent in quality and performance.

The ColorPro is nicely built, although it feels light because, as on the IBM 6180, the power transformer is external. Like other small HP plotters, this device is composed of sturdy plastic that should stand up well over time. The paper loading mechanism uses electronic actuation instead of the mechanical lever installed on the 7470.

The ColorPro's control panel uses international-style icons instead of English designations. As I mentioned in the review of the IBM version, these symbols are much less helpful than more-straightforward text labels.

The ColorPro has a slot on the bottom that accommodates a plug-in enhancement


FACT FILE

Hewlett-Packard ColorPro 7440
 Hewlett-Packard
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 San Diego, CA 92127
 (619) 487-4100
List Price: \$1,295
In Short: First-rate output and traditional HP quality in this rather costly eight-pen A-size plotter.
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PC LABS: SIZING UP THE PLOTTERS

The two most important considerations when shopping for a plotter are output quality and plot speed.

PC Magazine Labs aims to build an objective, quantified foundation for product reviews, which are, to some degree, subjective. The lab data and the interpretation of that data, combined with each reviewer's independent evaluation of the product, result in a review that we hope is useful in making real-world comparisons between products competing for your purchase decision. In the Labs, we test, prod, gauge, probe, and clock to give you something better than meaningless or arcane statistics that have no bearing on how a product really works.

Many personal computer products have a long list of technical factors that you should consider before purchasing, but, in some ways, plotters are less complex than most other hardware. The most obvious issue is how large a plot can be created, but this hardly needs PC Labs confirmation. If you buy a plotter to create blueprints or architectural designs with CAD software, you'll want at least a D-size and probably an E-size device. If your needs focus on business presentations and overhead transparencies, a B- or even an A-size plotter may be fine.

Probably the most important single issue is the visual quality of the finished plot. In some disciplines this is crucial. There can't be any unintended line breaks on a plot depicting a printed circuit board, for example. In all cases the main motivation in buying a plotter is to achieve higher quality than can be obtained from alternative output devices.

A plotter's output quality stems from a combination of many mechanical factors in its design, such as plotting speed, pen design, media type, and repeatability. To let you judge the quality of plotter output for yourself, we've published magnified segments of our test charts and text.

The time required to plot a chart varies widely. This matters much more than

you may think. Even the fastest plotters PC Labs has tested can take a half-hour or more to plot particularly complex images, and the slower units can take a couple of hours. Not all charts take this long, but a plotter's throughput obviously can translate directly into dollars and cents. A plotter's speed is also due to a combination of mechanical constraints in the design, pen type, how quickly the plotter's internal math routines work, and many other factors.

To maintain consistency, we replicated the setup that we used to evaluate 24 plotters last December, running the same IBM PC—equipped with 640K bytes of RAM and a dual 10-megabyte Bernoulli Box—at the standard 4.77-MHz clock rate. Once again, we chose *KeyChart* business graphics software by Softkey Software Products (see sidebar "KeyChart: Plotter Driver of Choice") and used it to generate the same test chart—which contains plenty of text and those nasty diagonal lines that often cause plotters to stumble.

KeyChart lets you choose between the character set stored in a plotter's ROM or the much more complex, multistroke text fonts created by the software. ROM fonts are always significantly faster than complicated software fonts because many fewer instructions are necessary to draw each letter. Of course, a ROM font is immutable, while software can generate a wide variety of type styles. The ROM fonts in the plotters tested varied from downright ugly to reasonably attractive. To help you compare the plotters and decide whether the trade-off between plot time and text quality is important to you, we timed each plotter using both ROM and software fonts and commented on the appearance of the ROM font.

For consistency, we also operated all the plotters using serial ports at the same 2,400-bit-per-second rate used in our

earlier benchmark tests. Since some small plotters can't accept data at a faster rate, this decision lets you compare all the plotters directly. In the real world, though, you would run your plotter at the fastest rate your hardware and software could support.

Perhaps surprisingly, the faster transmission doesn't matter all that much with many plotters because their mechanical limits are such that they rarely, if ever, wait for data from the computer. Some of the larger, more expensive plotters run noticeably faster with higher serial data rates, however, and those equipped with parallel ports can offer both faster plotting and easier connection. Since the differences are greater with the software font tests, the ROM-font comparisons are perhaps more revealing of the true differences between units. In any case, while our benchmark tests are accurate for comparing one plotter to another, they aren't meant to indicate exactly how long a given plotter might take to plot our test chart in your office.

We used the pens and media that the manufacturer supplied with each plotter, since they can affect the appearance of the finished charts. While pens came with each device, a couple of manufacturers didn't supply paper samples. In these cases we used a standard plotter paper sold by a popular computer supply company.

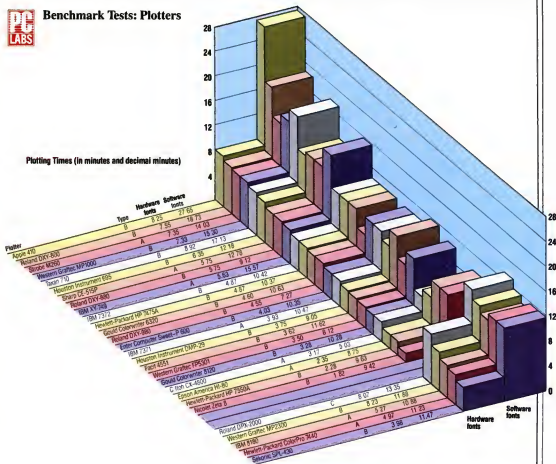
The result is that we maintained comparability with last year's tests in all respects. For your convenience, we've included the performance test results from the A-, B-, and C-size plotters tested last year with the results from the same-size plotters tested for this issue. Look for similar treatment of new D- and E-size plotters (and several printers that are being marketed as plotter alternatives) in the next issue of *PC Magazine*.

—Glenn Hart



Benchmark Tests: Plotters

Plotting Times (in minutes and decimal minutes)



Of the desktop plotters reviewed in this issue, the nearly identical IBM 6180 and the Hewlett-Packard 7440 (both manufactured by Hewlett-Packard and both Editor's Choices), performed best overall. They took third and second place respectively in the hardware font test and first and second place respectively in the software font test. The inex-

pensive Sekonic ran away from the field in hardware font testing, but managed only an average pace in software testing. The Western Graphics turned out average times for both tests, but the feature-laden Roland poked along, coming in 2 minutes slower than any other machine. Compared to the machines reviewed in *PC Magazine* last December, the plotters

reviewed in this issue produced, at best, average times. As you can see in the bar chart, nearly half of the earlier plotters beat the IBM and HP in both speed tests. For complete reviews of the 23 desktop plotters evaluated last December, see "Adding A Touch of Color," *PC Magazine*, Volume 4 Issue 26.

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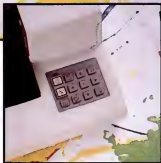
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■ NEW PLOTTERS



The Hewlett-Packard ColorPro 7440 (A size) costs \$10 more than its twin, the IBM 6180, and shares Editor's Choice honors with that machine. For the extra money, you get black keys instead of brown on the control panel, a different label, and equivalent results in our benchmark testing. Both produce the first-rate plots expected from an industry standard.



cartridge identical to that described in the IBM review. Hewlett-Packard didn't include one with the sample plotter, but its absence didn't appear to have any effect on the quality of the test plots I obtained.

HP's documentation is very good but perhaps a bit less comprehensive than IBM's. HP does not provide the serial-port-interface test on disk or the shorting-test plugs that IBM includes. Neither company supplies the detailed programming guide to the HPGL graphics language that was included with the earlier (and less expensive) Hewlett-Packard 7470. I regret this omission, although it's probably true that few purchasers ever used the language description guide (which, however, is available at extra cost).

The ColorPro's benchmark test plots

were identical to those of its IBM clone. Quality was very good, with plenty of "snap" and visual appeal. The ColorPro's plotting time was a few percentage points faster than the IBM's on the ROM-font plot and a few percentage points slower on the software-font chart. Whether this difference is due to sample-to-sample variation or to some minor contribution from the IBM enhancement cartridge is difficult to assess, but the differences were, in any case, insignificant. The execution times were solidly middle of the pack, as is usual with HP desktop plotters.

The ColorPro gives you a little bit less than its IBM cousin for \$10 more, but most users won't need the interface disk or shorting-test plugs anyway. The ColorPro is far from the least-expensive A-size plot-

ter around, but if you consider that it costs only about \$150 more than its less-capable 7470 ancestor, its price isn't out of line. What you do get is very good performance, compatibility with almost all business graphics and CAD software, and the Hewlett-Packard name and reputation.

Western Graphtec MP2300

When PC Magazine Labs tested Western Graphtec's MP1000 last year, we found it a reasonably competent performer with various problems. At the time, the company alluded to a greatly improved version of the B-size device in the works, and the Western Graphtec MP2300 is it.

While it is still plagued by several problems, the MP2300 offers more features and performance for only a little more money. It has eight pens instead of six, and, more important, the pens are now automatically capped when not in use to prevent drying (the pens are held in their stalls with magnets, incidentally: placing floppy disks in the vicinity is discouraged). At 15 inches per second, plot speed for the MP2300 is more than twice as fast as for the MP1000 (6 ips). And, among other improvements, the specification for accuracy is three times higher.

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FACT FILE

Western Graphtec MP2300

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- Keep up to 6 files open at once
- Non-protected version available to registered owners
- Compatible with IBM PC Network

For the IBM-PC, XT, AT & PCjr \$54.

Executive Systems

- XTREE 2.0 (file & directory manager) 37.

5th Generation

- Fastback 5.13 97.

Font Software

- Sideways 3.11 39.

Graphic Communications

- Freedom (not copy-protected) 199.

Great American

- One Write Plus 1.01 159.

- Add-on modules (A/R A/R, Payroll) each 133.

Harvard Associates

- PC LOGO 2.0 69.

Infocom

- Cornerstone 5.2 59.

Liteline

- Volkswagon 3.1.0 147.

Living Videotext

- Ready Tank 2.1 105.

Micro Education (MECA)

- Managing Your Money 2.0 115.

Micropro

- WordStar 3.31 179.

Microfilm

- WordStar Prolog 3.31 259.

Microform

- R-base 5000 1.01 285.

Microsoft

- R-base System V 369.

Microsoft

- Windows 1.01 65.

Microsoft

- Multipan 2.0 119.

Microsoft

- Microsoft Access 1.01 163.

Microsoft

- Microsoft Word 3.0 247.

Microsoft

- Microsoft Project 2.01 239.

Microsoft

- Microsoft Chart 2.0 197.

The following Microsoft mice now come with PC Paintbrush 3.0 software:

- Microsoft Bus Mouse with software 5.03 \$127.
- Microsoft Serial Mouse with software 5.03 135.

LANGUAGES

- Quick Basic 2.0 59.

- Macro Assembler 4.0 97.

- Fortran Compiler 3.31 229.

- C Compiler 4.0 279.

Microsoft

- Crosstalk XVI 3.61 95.

- Remote 1.3 95.

Migent Software

- Ability 1.0A 65.

Multimate International

- MultiMate 3.31 call

- MultiMate Advantage 3.6 call

Nantucket Software

- Clipper (Winter '85 version) 349.

Paperback Software

- VP-Planner 1.0 57.

- VP-Info 1.0 special

Parsons

- SmartNotes 1.0 49.

Peter Norton

- Norton Commander 1.0 36.

- Norton Utilities 3.1 59.

Quarterdeck

- DESQView 1.2 65.

Simon & Schuster

- Webster's New World Speller 1.2 39.

- Webster's New World Writer 1.01 (includes Thesaurus & Speller) 109.

Webster's New World Thesaurus

- Software Group (not copy-protected) call

Software Publishing

- PFS Report B.01 77.

- PFS:File B.01 84.

- PFS:Graph B.01 84.

- PFS:Text C.01 84.

- Harvard Presentation Graphics A-00 245.

- Harvard Total Project Manager 1.1 289.

Not copy-protected versions due to be released soon—call.

Springboard

- Newsroom 35.

- Clip Art Volume 1 (for Newsroom) 19.

- Clip Art Volume 2 (for Newsroom) 25.

True BASIC, Inc.

- True BASIC 1.0 109.

- True BASIC Fireworks (incl. 3 libraries) 159.

WordPerfect Corp.

- WordPerfect 4.1 239.

- WordPerfect Library 59.

TRAINING

ATI

- SKILL BUILDER PROGRAMS

- Intro and How to Use:

- PC-DOS MS-DOS

- Compaq Typing Tutor

- IBM-PC BASIC each 33.

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erall output.

TRAINING POWER PROGRAMS

How to Use:	
Lotus 1-2-3	Wordperfect dBase III Plus
WordStar	Displaywrite 3
Symphony	each \$43.
Individual Software (copy-protected)	
* The Instructor II	26.
* Professor DOS	33.
* Tutorial Set (both items above)	49.
* Typing Instructor	26.
* Training for Lotus 1-2-3 (for vers. 1A & 2)	37.
* Training for dBase III	37.
* Training for Project Management	37.
Simon & Schuster (not copy-protected)	
* Typing Tutor III	33.

EDUCATIONAL

All educational programs listed are copy-protected.

Barron's	
* Computer SAT	35.
Designware (reqs. graphics brd.)	
* Spellcopter (ages 6 to adult)	22.
Eduware (reqs. graphics brd.)	
* Algebra 1,2,3, or 4	22.
Harcourt Brace Jovanovich	
* Computer SAT	49.
Stone (reqs. graphics brd.)	
* My Letters, Numbers, Words (ages 1 to 5)	27.
* Kids Stuff (ages 3 to 8)	27.
The Learning Company (reqs. graphics brd.)	
* Reader Rabbit (ages 5 to 7)	26.
* Rocky's Boots (ages 9 and up)	32.

RECREATIONAL

All recreational programs listed are copy-protected except where noted.

Blue Chip	
*Baron	36.
*Millionaire	36.
Electronic Arts (reqs. graphics brd.)	
*Pinball Construction Set	24.
*Music Construction Set	26.
*Dr. J/Larry Bird One-on-One	28.
Hayden Software (reqs. graphics brd.)	
*Sargon III (highest rated Chess program)	32.
Infocom (not copy-protected)	
Difficulty levels shown in <i>italics</i>	
* JUNIOR	
Seastalker	24.
STANDARD	
*Enchanter	*the Witness *Planetfall
*Cuthroat	*Wishbringer *Zork I
*Ballyhoo	Footballyzky
*Hitchhiker's Guide	each 24.
* ADVANCED	
Zork II	Zork III Sorcerer
A Mind Forever Voyaging	each 27.
* EXPERT	
Spellbreaker	Suspended each 29.

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through October 31, 1986

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In the beginning, Hayes created the Smartmodem. And we've been selling it ever since. But, variety is the spice of life, and one thing we Marlowites pride ourselves on is our spiciness, so read on...

- Fully Hayes compatible, including extended command set
- 300/1200 baud operation, bell 103 and 212A compatible
- Auto answer, auto dial, auto redial
- Configurable from COM 1—COM 4
- Software-adjustable volume control
- Touch-tone or pulse (rotary) dialing
- Automatic data-to-voice transition
- All this on a HALF-SLOT card!!

For the IBM PC, XT and AT ... \$137.

Invisclues (hint booklets). Specify game	6.
Microleague Sports (reqs. graphics brd.)	
* Microleague Baseball	25.
Microprose (reqs. graphics brd.)	
* F-15 Strike Eagle	22.
Microsoft (reqs. graphics brd.)	
* Flight Simulator 2.12	32.
15Step Software (reqs. graphics brd.)	
* Golf's Best (Pinhurst or St. Andrew's)	19.
Parlor Software (not copy-protected)	
* Bridge Parlor (best Bridge simulation)	49.
PCSoftware (not copy-protected)	
* Championship Blackjack	25.
Sierra On-Line (reqs. graphics brd.)	
* King's Quest II	33.
Simon & Schuster	
* Star Trek/Kobayashi	27.
Spectrum Holobyte (reqs. graphics brd.)	
* GATO	27.
Sublogic (reqs. graphics brd.)	
* Night Mission Pinball	29.
* Jet	33.
* Scenery (export) disks for Jet	each 69.
* Package of all 6 Western Airports	69.
XOR (not copy-protected)	
* NFL Challenge (be the coach)	79.



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290M

HARDWARE

Manufacturer's minimum limited warranty period is listed after each company name. Some products in their line may have longer warranty periods.

AST Research ... 1 to 2 years

SixPakPlus 64k C/S/P includes Sidekick vers. 1.5 not copy-protected & DESQView ... \$169.
SixPakPlus 384k (fully populated) ... 219.
SixPakPremium 512k C/S/P upgrades to 1 Meg, fully compatible with LOTUS/INTEL expanded memory specification (EMS), includes DESQView ... 369.

AST-5251-11

Advantage 128k; upgradeable to 1.5 Meg includes Sidekick version 1.5 not copy-protected and DESQView ... 369.
RAMpage! 256k; upgradeable to 2Mb ... call
RAMpage! AT 512k; upgradeable to 2Mb ... call
Both RAMpage boards support EMS and fully support EEMS, and include DESQView.

Amdex ... 2 years

Video 310A mono monitor (amber) ... 159.
Color 722 - EGA compatible ... 519.

Compuable ... lifetime

Plastic Keyboard & Drive Cover Set ... 15.
IBM Mono Screen Enhancement ... 17.

Cuersta ... 1 year

Uninterruptible power backup units.
Datascrver 400 Watt ... call

Curtis ... lifetime

ACCESSORIES

* Low Profile Tilt and Swivel Pedestal ... 25.
* PC Pedestal (for IBM Mono or Color) ... 27.
* Portable Pedestal (for portable computers) ... 36.
* Printer Stand ... 19.
* System Stand (for IBM-PC & XT) ... 19.
* Universal System Stand ... 25.
* Crystal 300 Watt (line conditioner) ... 159.

CABLES

Smartmodem to IBM Cable ... 17.
Keyboard Extension Cable (3 to 9 feet) ... 27.
Extension Cables for IBM Mono Display ... 33.
Color and Monochrome Extension cables ... 39.
Printer-to-IBM cable ... 17.

SURGE SUPPRESSORS

* Safestrip (6 outlets) ... 21.
* Diamond (6 outlets) ... 29.
* Emerald (6 outlets; 6 ft cord) ... 36.
* Sapphire (3 outlets; EMV/RFI filtered) ... 47.
* Ruby (6 outlets; EMV/RFI filtered; 6 ft cord) ... 55.
* Command Center ... SPECIAL ... 79.

DCA ... 1 year

Imma ... 729.

Epson ... 1 year

* EX-800 (80 column, 300 cps) ... call
* FX-85 printer (80 column) ... call
* FX-286 printer (136 column) ... call
* LX-86 printer (80 column) ... call
* LO-1000 printer (136 column) ... call
* LO-2500 (136 column, 324 cps) ... call
* Printer-to-IBM cable ... 15.

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Everex ... 1 year

Evercom II Internal modem w/software special

Hayes ... 2 years

* Smartmodem 1200	389.
* Smartmodem 1200B (1/2 card, w/Smartmod II)	349.
* Smartmodem 1200B (1/2 card, no software)	319.
* Smartmodem 2400	589.
* Smartmodem 2400B (w/Smartmod II)	529.
* Smartcom II 2.1 (software)	89.

Hercules ... 2 years

All Hercules boards come with parallel port and FREE parallel printer cable

* Hercules Color Card	159.
* Hercules Graphics Card	189.
* Hercules Graphics Card Plus	189.

Intel ... boards: 5 years; chips: 1 year

* Above Board PC 64k (upgrades to 2 Meg)	call
* Above Board AT 128k (upgrades to 2 Meg)	call
* Above Board PS 64k C/SIP (upgrades to 1.5 Meg)	call
* Above Board PS AT S/P (upgrades to 1.5 Meg or higher w/piggyback)	call
* 8087 (for IBM-PC & XT)	129.
* 8087-2 (for 8 Mhz computers)	177.
* 80287 (for 6 or 8 Mhz IBM-PC AT)	225.
* 80287-8 (for 10 Mhz & faster IBM-PC AT)	269.
* Kensington Microwave ... 1 year	
* Masterpiece	94.
* Masterpiece Plus	129.
* Printer/portable computer stand	17.

key tronic ... 90 days

5150 keyboard	115.
5151 keyboard (Deluxe)	169.

Kraft ... 1 year

* New! 3 Button Joystick	35.
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Mouse Systems ... lifetime

* PC Mouse with PC Paint+	127.
* PC Mouse with Ready and PC Paint+	149.

NEC ... 2 years

* Multisync monitor (EGA compatible)	579.
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NSI Logic ... 3 years

* EPIC (video adapter, EGA compatible)	279.
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Orchid Technologies ... 1 to 2 years

* Conquest Multifunction Board (2x upgrades to 2Mb, fully supports EMS spec)	264.
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Ecocall Multifunction Board for the AT

399.	
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Tim Turbo 286

445.	
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PC Turbo 286 w/1 Meg

739.	
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Turbo EGA

589.	
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EGA

289.	
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Paradise Systems ... 1 year

* Color/Mono Card	149.
* Five Pack w/384k	159.
* Auto Switch EGA	359.

Princeton Graphics ... 1 year

* MAX-12E Amber monochrome monitor	179.
* HX-12 RGB monitor (890 x 240)	449.
* HX-12E (EGA compatible)	539.

Quadram ... 1 to 2 years

* Expanded Quadboard	
Qik (upgrades to 384k)	99.
384k (fully populated)	149.

* MicroLaser Printer/buffer 64k (parallel)	159.
--	------

* QuadEGA+ (half-card)	349.
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PC Connection Service Center

Did you know that we are an authorized Epson and OMEGA service center? We typically offer twenty-four hour turnaround on serviced items. Our labor charge is only \$25 per hour. Call 1-800-PCC-TECH extension 138 for a free telephone diagnosis.

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PC-Document Keyboard Templates

available for:

* DOS/Basic 3.0-3.1	WordStar
* Lotus 1-2-3	WordStar 2000
* Symphony	MultiMate
* Framework	WordPerfect

each \$12.

Toshiba ... 1 year

All Toshiba printers listed are 24 pin dot matrix.

* P321 serial/parallel printer (80 col)	519.
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* P351 serial/parallel printer (136 col)	1089.
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Toshiba T1100 PLUS Laptop Computer ... call

Toshiba T3100 Laptop Computer ... call

Video ... 2 years

* VEGA (half-card)	349.
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DRIVES

I2 interface ... 1 year

20 Meg Hard Drive Card (85 ms)	459.
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IOmega ... 90 days

* Bernoulli Box 20 Meg w/PC2 card	1649.
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* 10 Meg cartridge	51.
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* Bernoulli Box 40 Meg w/PC2 card	2449.
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* PC2B (Bootable) Card	229.
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* 20 Meg cartridge	67.
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* Bernoulli Box Car Kit	79.
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Mountain Computer ... 1 year

Drive Card 20 Meg (80 ms)	call
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Drive Card 30 Meg (78 ms)	call
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Seagate ... 1 year

20 Meg Internal Hard Drive (w/controller and cables, 65 ms)	409.
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20 Meg Internal Hard Drive for the AT (40 ms)	569.
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TEAC ... 1 year

FD-55BV Drive (5 1/4" half-height)	109.
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Toshiba ... 1 year

PC, XT 360k Drive (5 1/4" half-height)	109.
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AT 360k Drive (5 1/4" half-height)	117.
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CIRCLE 339 ON READER SERVICE CARD



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64k Memory Upgrade Set for IBM-PC or XT

system board or any memory board	
150 nanosecond (set of 9)	\$15.

* 128k Memory Upgrade Set for IBM-AT System Board (9 chips piggybacked)	39.
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* 256k Memory Upgrade Set for any IBM-AT memory board (9 chips)	39.
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DISKS

All disks have a lifetime warranty.

DS/DD Disks for the PC & XT (40 TPI)

* Verbatim Datafile (10 disks per box)	15.
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* Maxell MD-2 (10 disks per box)	19.
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DS/High Density Disks for the AT (96 TPI)

* Fuji (10 disks per box)	27.
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* Verbatim (10 disks per box)	29.
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* Maxell (10 disks per box)	34.
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* Flip Sort (holds 75 disks)	15.
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* Kalmor Teakwood Disk Holder (holds 50)	19.
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* Kalmor Teakwood Disk Holder (holds 100)	29.
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* Floppicide Disk Drive Cleaner (5 1/4")	18.
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* Innovative Concepts Flip'n' File 50	16.
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INFORMATION SERVICES

Compuserve

* Compuserve Information Service (includes subscription, manual, \$25 usage credit, monthly publications)	24.
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- We accept VISA and MASTERCARD. (Only on U.S. & Canadian orders)
- No charge added for charge orders.
- Your card is not charged until we ship.
- If we must ship a partial order, we never charge freight on the shipment(s) that complete the order.
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- All shipments insured; no additional charge.
- Allow 1 week for personal and company checks to clear.
- UPS Next-Day-Air available.
- COD max. \$1000. Cash or certified check.
- 30 day limited warranty on all products.*
- To order, call us anytime Monday thru Friday 9:00 to 9:00, or Saturday 9:00 to 5:30. You can call our business offices at 603/446-3383 Monday through Friday 9:00 to 5:30.

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Note: Accounts on net terms pay actual shipping. **Continental US:** For monitors, printers, and drives, add 2% for UPS ground shipping. Call for UPS Blue or UPS Next Day-Air. For all other items, add \$2 per order to cover UPS shipping. We will automatically use UPS 2nd-Day-Air at no extra charge if you are more than 2 days from us by UPS ground. **Hawaii:** For monitors, printers, and drives, actual UPS Blue charge will be added. For all other items, add \$2 per order. **Alaska and outside Continental US:** Call 603/446-3383 for information.

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* DEFECTIVE SOFTWARE REPLACED IMMEDIATELY. DEFECTIVE HARDWARE REPLACED OR REPAIRED AT OUR DISCRETION. SOME ITEMS HAVE MANUFACTURER'S WARRANTIES UP TO FIVE YEARS.



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In the enigmatic town of Marlow, NH (pop. 544), there's nothing we like better than a good fit. Fields and streams. Peaches and cream. You and your lean mean micro machine.

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Just call 1-800/243-8088 or 1-603/446-3383, M-F 9:00 to 9:00; Saturday to 5:30. If you're planning to visit, call ahead to make sure what you want is in stock.



The PC Connection puzzle, featuring our co-founding little mascots in one of their most famous poses. Suitable for beginners and advanced users. Offer not available to net accounts. Limit one per customer.

For the IBM-PC (XT & AT) exclusively.

PC CONNECTION

■ NEW PLOTTERS

should have been a real plus.

But, while electrostatic hold-down is preferable to mechanical mounting, the MP2300's system is no better than adequate. Even after extended smoothing with my hand and then with a card, the MP2300 did not always hold the medium down correctly. Air pockets occasionally formed under the central portion of the plot bed, resulting in a few charts ruined by pen scarring.

Three graphics languages are built in—including two that match Graphtec's own MP1000 and FP5301 plotters—and an HPGL emulation that renders the MP2300 compatible with a huge variety of commercial software. RS-232 serial, Centronics parallel, and IEEE interfaces are available. A generous 6K data buffer is standard.

The MP2300 offers an unusually wide variety of internal character sets, including those for various European languages, Japanese, and even Chinese. Pen availability is equally broad; water- or oil-based fiber-tip, water-based ballpoint, ceramic, and ink pens can be used. On the other hand, the control panel is limited and not particularly well made, and the documentation, while complete, is dry and engineer oriented. Twelve DIP switches on the bottom of the plotter must be set to configure the interface, but they are clearly marked; it is not difficult to set things up correctly if you understand the issues at hand.

The internal font is not particularly attractive and might not be acceptable for some critical applications. The plotter also seems distinctly slower than its pen speed specification would suggest. While the

■ The MP2300 is a lot more plotter than its ancestor and, for a relatively low-cost B-size plotter, not a bad value at all.

MP2300 was some 15 percent faster than the older MP1000 using the plotter's hardware font and 32 percent faster using Key-Chart's software fonts (in the native Graphtec language and using the serial interface), the plotting times are still nothing to write home about. PC Labs also tested the HPGL emulation and found it somewhat slower than the native language mode. Plot quality overall was good, but, again, not earthshaking.

The MP2300 is a lot more plotter than its ancestor and offers reasonable performance for a relatively low-cost B-size plotter. There are plotters that are faster and produce better plots, but the MP2300 is a step in the right direction for Western Graphtec, and, given its price, not a bad value at all.

Sekonic SPL-430

The days when the Japanese simply copied American designs—usually with lower quality and correspondingly lower prices—are generally over. Whether cameras, hi-fi equipment, or cars, Japanese products are now innovative and well made.

At first glance, the B-size Sekonic SPL-430 plotter seems in many ways a throwback. Manufactured by a Japanese firm with a well-established reputation in light meters and chart recorders, it's obviously a clone of the Hewlett-Packard 7475A, which has become something of a standard in B-size desktop plotters. Paper loading is similar, the design of the six-pen carousel is similar, the HPGL-compatible graphics language is similar, the physical layout of



The Western Graphtec MP2300 (B size) suffers from flaws that compromise its otherwise excellent value. For example, while electrostatic hold-down is generally the best approach to securing media, Western Graphtec's implementation of this technology is only adequate. More on the downside: poor control-panel design and slow HPGL emulation. On the upside: a wide variety of character sets and pen types. And the price is impressive: at \$1,250, much can be forgiven.





dBug/EGA

The only debugger designed especially for the new EGA graphics standard is now available from Cybernetic Micro Systems

only **\$99** (not copy protected)

User Interface

dBug/EGA is a program that uses six dedicated windows to step through your code:



Animation

A free demo program, the Star Juggler, provides source code to show you how to take advantage of EGA features as you learn to use the debugger. A 100+ page manual, with numerous screen dumps, walks you through the demo.

Font Creation

dBug/EGA allows you to create new characters easily. Issue the "F" command. Then use the cursor keys to select a pixel in the 6 x 14 font array. Then "+" or "-" will set or reset the pixel. When you finish creating the new character, "ESC" will save it, and your program can now use it. New fonts can be saved to disk and then reloaded for future use.

Color Palette

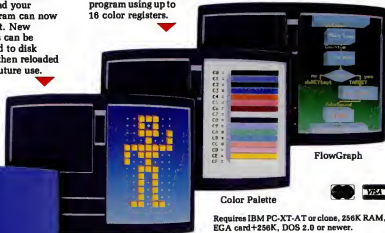
dBug/EGA allows you to easily alter any color in any palette register by typing Cn=color, where Cn stands for register #n. For example, C3=2 will change color register 3 to green (=2). This feature allows you to quickly try new color schemes in your graphics program using up to 16 color registers.

Multi-Window Debugging

dBug/EGA saves the "User Screen" when a breakpoint is reached and replaces it with a multi-window "debug Screen" for single stepping through Assembly Language Source Code that you write. dBug/EGA displays your names and labels along with registers, stack, and memory values. dBug/EGA even draws a flowgraph for your documentation. On-line help is always available, and the single-key commands will prompt for any required parameters. The debug screen and application (user) screen are maintained separately, and either can be viewed on command.



Animated Demo (Free with dBug/EGA)



Font Creation

Color Palette

FlowGraph

Requires IBM PC-XT-AT or clone, 256K RAM, EGA card+256K, DOS 2.0 or newer.

dBug/EGA\$99
dBug86 (non-EGA version)\$99
EGA utility source code\$99

*California residents add sales tax.



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PENS AND MEDIA

It takes more than a fancy new plotter to create slick-looking charts.

Most plotter owners simply start using the pens and media that come with their new plotters and reorder the same items as needed. But they have many other choices, and there are many good reasons for considering them. The most important thing to know is that different combinations of pens and media interact in very specific ways. Matching them is essential to extract the best image quality from your plotter.

Pens are usually categorized by the material used for the tip and the type of ink used. The most common types are fiber-tip, ceramic, ballpoint, liquid-ink and disposable liquid-ink pens (sometimes referred to as liquid-roller pens).

FIBER-TIP Fiber-tip pens are by far the most prevalent and popular. The tip is usually made of nylon or a similar plastic of varying hardness. This tip allows ink to flow easily, so that plotting speed can be moderate to high without skipping. The tips can be made reasonably narrow or rather wide, which gives you flexibility in selecting wide pens for headings and area fill and narrower pens for fine detail. The tips wear out over time; how quickly depends on the abrasiveness of the media and the pressure applied by your plotter. The pens must be capped either manually or automatically (if your plotter includes this convenient feature) to prevent the ink

from drying out from exposure.

Fiber-tip pens are available with either water-based or oil-based inks. Water-based ink is used for paper media, including both bond and coated papers, and oil-based for overhead transparency film.

CERAMIC AND BALLPOINT Ceramic pens protect the tip with a hard, durable ceramic. This tip keeps a consistent line width over the full life of the ink supply. Ceramic tips are best used with standard bond paper rather than coated stocks, and they must be used at somewhat slower speeds than fiber-tip pens. You also have to be more careful with them; the ceramic tip is rather delicate.

Ballpoints also offer consistent and sharp line quality over the life of the pen, although their colors are usually not as saturated and vivid as fiber tips. Like fiber tips, they're available with water-based or oil-based inks, but either type is designed for paper media only. The oil-based pens are often pressurized with gas during manufacture, which forces the ink to flow evenly during very high-speed plotting.

LIQUID INK Liquid-ink pens are the Cadillac of plotting pens. Line quality is superb and consistent, and tips in various widths are available. Plotting speed should be much slower than with other

pen types to assure smooth and even ink flow. Various materials can be used for the pen tips to suit visual requirements and the media used.

Choosing the ink is an interesting sub-specialty. Ink viscosity, drying times, and many other factors can be manipulated. Filling liquid-ink reservoirs can be messy and inconvenient, though. The ink can solidify in the tips, and scrupulous cleaning with solvents or ultrasonic cleaners is essential.

Much of the mess and inconvenience of traditional liquid-ink pens can be avoided with disposable liquid-ink pens. Performance is excellent, and cost is only slightly higher than for fiber-tip pens (although considerably more than for reusable liquid-ink pens).

PAPER Your media options are equally broad. Besides the obvious issue of size, the various types offer compromises between cost, visual appeal, longevity, and stability under varying humidity and temperature conditions.

The most popular choice for many users is standard bond and chart paper. Paper specifically designed for plotter use is of higher quality than copier bond and somewhat smoother. Bond paper's relatively rough surface can wear fiber-tip pens (so ceramic and liquid-ink pens are better choices), and the paper's absor-





bency can sometimes result in ink spread or blotting. Even so, this is the least-expensive media option, and good results can be obtained readily.

Coated presentation paper is a high-quality paper with a smooth and glossy surface coating on one side. The coating prevents ink spread and gives excellent results with fiber-tip pens. Liquid-ink and ceramic pens can dig into the coating and clog on the paper fibers below, so they are best avoided with this paper.

TRANSPARENCIES Overhead transparency film requires oil-based fiber-tip pens. Using plotters to prepare overhead transparencies is so common that many manufacturers include transparency film and pens with their units, and all make suitable pens available.

Professional drafting is often done on a completely different type of film—mylar. Mylar is stable—shrinking or expanding little with changes in humidity—so that it is excellent for high-precision use. But mylar is quite abrasive, and sometimes silica particles are coated on the film to improve ink adhesion. Special tungsten pen tips are available for many styles of liquid-ink pens specifically to deal with this abrasive medium.

The media and pens supplied by your plotter's manufacturer are a good starting point for investigating your options. The availability of several pen widths, types, inks, and colors is an important factor to consider when selecting your plotter, especially if you intend to use media other than standard paper. —Glenn Hart



No design standard exists for storing, dispensing, and retrieving pens. As you can see from the photographs, manufacturers employ a variety of techniques. The E-size Houston Instrument DMP-56 (above left) can hold only one pen at a time in the pictured carriage; if you want a different color or pen width, you must change the pen yourself. The HP ColorPro 7440 (above center) and its twin, the IBM 6180, store eight pens in this Gaiking gun-like carousel, which rotates as needed to proffer the selected pen to the pen carriage. The Bruning Zeta 836 (above right) carries eight small pens in the pictured carriage, lowering each pen as needed.

The pen tip used to create a plot determines the sharpness of the image and the vibrancy of the colors and is a contributing factor to plotting speed and esthetic quality. Pictured left to right are five standard pen types: fiber tip, ceramic tip, ballpoint, liquid ink, and disposable liquid ink. The fiber-tip pen offers all-around economical performance: high speed, bright colors, and a variety of pen widths. Ceramic tips outlast fiber tips but drag speed down. Ballpoints offer consistently sharp line quality at very high plotting speeds but suffer from duller colors. For best overall line quality, the liquid-ink pen is the tip of choice, but it also drags plot speed down and is very messy. Disposable versions of these pens offer the performance of liquid ink without the mess, but they are more costly. The pen tips pictured to the left were supplied by Koh-I-Noor (100 North Street, P.O. Box 68, Bloomsbury, NJ 08804, (201) 479-4124).

■ NEW PLOTTERS



FACT FILE

Sekonic SPL-430
Siber Hegner North America Inc.
Five Landmark Sq.
Stamford, CT 06901
(203) 967-4441
List Price: \$1,595

In Short: A very competent B-size plotter derived from the Hewlett-Packard 7475A.

CIRCLE 661 ON READER SERVICE CARD

the plotter is similar, and so forth.

There are some differences, however. On the plus side, the SPL-430's rated plotting speed is higher, and both serial and parallel interfaces are standard. On the minus side, the carousel is much flimsier than

the HP design, and the operator panel consists of a flat membrane rather than discrete buttons.

The panel is reasonably complete, but lacks buttons to extract and store pens and to change media size. On the SPL-430, you must change a DIP switch on the rear of the plotter to indicate whether the medium is A, B, or the European equivalent size, which is much less convenient if you routinely use both A- and B-size media. The membrane "buttons" are garish orange and yellow—a color scheme that detracts from the professional appearance of the plotter.

But my impressions of the SPL-430 began to change as soon as I started plotting with it. Plot quality is first rate, very much in the same league as the HP/IBM plotters.

The output has the same "polish" and subjective appeal as charts done on the HP. The ROM font is very much like the HP's, too, and was more than adequate for many presentations.

Using the serial port and the standard bit-per-second rate for all the plotter tests, the Sekonic SPL-430 was 18 percent faster than an HP7475A using its internal fonts, but 10 percent slower using software fonts.

PC Magazine Labs also tested the parallel port and found that although it didn't make any difference at all on the hardware-font benchmark test, it improved speed in the software-font test by almost 30 percent. Many users would choose the simpler parallel interface, and the SPL-430 is quite a bit faster than the HP7475A in this case too.

There are intangibles in buying any computer equipment, and frankly the Sekonic's domestic distributor, Siber Hegner North America, is hardly a household name like Hewlett-Packard, Houston Instruments, and IBM. The Sekonic SPL-430 will probably be hard to locate for a while (although it can be purchased directly from the manufacturer for the time being), and service is currently offered on a return-to-service basis. Nevertheless, the SPL-430 is a good performer that's both faster and less costly than many of its competitors. The new Sekonic is already popular in Europe, and it may do quite well here, too.

Roland DPX-2000

You may have seen the name on rock stars' synthesizers, but Roland, long a leader in the electronic-musical instrument field, has been making an equal mark in personal computer peripherals for some time. Roland's video monitors are very impressive, and its line of three plotters scored well in *PC Magazine's* plotter tests last year. Now Roland is extending its plotter line upward with the DPX-2000, a feature-laden, high-end, C-size, flatbed plotter.

The C size is a bit unusual in a market crowded with either A/B- or D/E-size units. Architects and many other users need the larger sizes, but printed circuit-board designers and users in some other disciplines may find the C-size DPX-2000



Based on the HP 7475A (see "Adding a Touch of Color: 24 Plotters, \$399 to \$5,950," PC Magazine, Volume 4 Number 26), the Sekonic SPL-430 (B size) tested significantly faster and costs less than its precursor, yet retains the impressive plot-making capability of the HP. However, carousel design is relatively flimsy, and the garish control panel lacks buttons to change media size and to extract and store pens.



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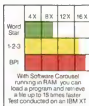
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■ NEW PLOTTERS

A CLOSE-UP LOOK AT PLOTTER PERFORMANCE

The most important test of a plotter's performance is plot quality. Representative output from the desktop plotters reviewed in this issue is pictured below. The samples shown are a fill, a diagonal-line pattern, a cross-hatch pattern, and text. The diagonal and cross-hatch patterns are the best tests of a plot's quality because the machine must accurately coordinate the simultaneous motion

of its vertical and horizontal motors. The completeness and quality of the filled bars, however, depend more on the width of the pen than on the machine itself; as you can see from these sample filled bars, which were made with a variety of wide and thin pen tips, ink coverage varies. Also, the quality of the text was fairly consistent among desktop plotters reviewed.

 U.S.  CANADA  EUROPE	 U.S.  CANADA  EUROPE	 U.S.  CANADA  EUROPE
Western Graphtec MP2300	Roland DPX-2000	IBM 6180
 U.S.  CANADA  EUROPE	 U.S.  CANADA  EUROPE	<p><i>Our two Editor's Choices, the IBM 6180 and the Hewlett-Packard ColorPro 7440, produced quality plots that were marred only by a slight wriggle in the diagonals. The Western Graphtec MP2300 gave good results but suffered from variances in the diagonals and from a flatness in the letter O. The excellent plots of the Sekonic SPL-430 were troubled only by slight bleeding at the corners. The outstanding plots of the Roland surpassed all others in their detail and accuracy, highlighted by sharp corners, straight diagonals, and first-rate text.</i></p>
Sekonic SPL-430	Hewlett-Packard ColorPro 7440	



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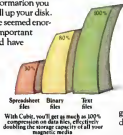
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■ NEW PLOTTERS

■ The DPX-2000

senses the pen type used and adjusts the writing speed and pen pressure automatically. A soft-landing system prolongs tip life.

a good trade-off between bulk and plot dimensions.

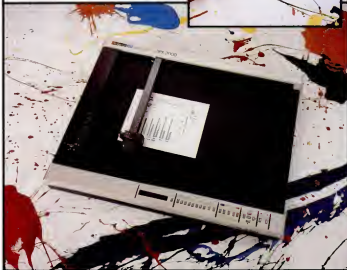
The DPX-2000 can be used horizontally or at angles of up to 80 degrees with the optional \$395 DPS-2 stand. This is a beautiful, heavy-duty, chromed-bar stand that adds to the aesthetic appeal of the system. An electrostatic hold-down system secures the medium to the plot bed. The "suction" is a bit stronger than that of some other electrostatic systems and holds the medium flat and secure.

The DPX-2000 senses the pen type used and adjusts the writing speed and pen pressure automatically. A soft-landing system prolongs tip life. The selection of available pens is very broad: it comprises water- and oil-based fiber-tip, ceramic, water-based ballpoint, and oil-based pressurized ballpoint as well as liquid-ink pens developed by Staedler of West Germany.

The DPX-2000 is the first Roland plotter to cap its pens automatically, and if a drawing command is not issued for a minute or so while a pen is over the media surface, the pen is returned to its stall to prevent drying.

The operator panel is a masterpiece of functionality and visual appeal. An LED readout displays the current *x* and *y* coordinates of the pen head; a button resets the origin from the default center point if desired. Other buttons extract the pens, enable the automatic pen-handling functions, position the head to the upper right or lower left, set scaling points in the P1, P2 HP tradition, position the head, adjust pen pressure, enable the electrostatic hold-

The Roland DPX-2000 (C size) offers advanced design and superb output as well as a high price and slow plotting speed. Features abound on this machine. An excellent electrostatic hold-down system secures the media. An automatic sensor adjusts writing pressure and speed to pen type, prolonging tip life. An automatic capping mechanism prevents pen tips from drying out. The control panel leaves nothing to be desired, visually or operationally. For pure, top-of-the-line quality, the DPX-2000 is a marvel. But it's also as expensive as some D- or even a few E-size plotters.



down system, clear the generous 15K-byte input buffer, and more.

The DPX-2000 has both serial and parallel ports. Sixteen DIP switches and a rotary bps-rate dial accommodate a variety of operating environments.

The DPX-2000's pen speed is rated at about 15 inches per second, which is reasonably fast, but it was far from the fastest we tested. Mechanical resolution is rated at a good .0125 mm, although the smallest step the software recognizes is twice this value.

The plots produced by the DPX-2000 were first rate. Their detail and accuracy were excellent, perhaps the best quality PC Magazine Labs has obtained to date with a flatbed plotter. Surprisingly, the Roland



FACT FILE

Roland DPX-2000

Roland DG
7200 Dominion Circle
Los Angeles, CA 90040-3647
(213) 685-5141
List Price: \$5,495

In Short: Elegant, beautifully built, and precise—but not the fastest plotter, and rather pricey for the features and performance offered.

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plotter turned out to be much slower than we had expected.

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Plotters: Summary of Features

	PC IBM 6180	PC HP ColorPro 7440	Western Graphics HP2300	Sekonic SPL-430	Roland DPX-2000
Specifications					
Retail price	\$1,285	\$1,295	\$1,250	\$1,595	\$5,495
Maximum paper size	A	A	B	B	C
Paper movement	Flatbed	Flatbed	Flatbed	Roller bed	Flatbed
Paper hold system	Grit wheel	Grit wheel	Electrostatic	Pinch wheel	Electrostatic
Number of pens	8	8	6	6	8
Pens auto-capped	●	●	●	●	●
Maximum pen speed (inches per second)	16 inches	16 inches	15.7 inches	22 inches	15.7 inches
Adjustable pen speed	●	●	●	●	●
Step size	0.001 inch	0.001 inch	0.0039 inch	0.001 inch	0.0005 inch
Accuracy	N/A	N/A	±0.3%	0.3%	±0.2%
Buffer size	60 bytes	60 bytes	6K bytes	N/A	15K bytes
Act as digitizer	●	●	●	N/A	●
Auto paper feed	○	○	○	○	○
Weight (pounds)	9	9	13.2	15.4	36
Interface					
Serial	Optional	Optional	Standard	Standard	Standard
Parallel	N/A	N/A	Standard	Standard	Standard
IEEE	Optional	Optional	Standard	Optional	N/A
Programming					
HPGL	●	●	●	●	●
Proprietary	○	○	○	○	○
Other	○	○	○	○	○
Bundled software	○	○	○	○	○
Subjective Evaluation					
Quality of construction	★★★	★★★	★★★	★★	★★★★
Ease of pen use	★★★★	★★★★	★★★★	★★	★★★★
Ease of paper insertion	★★★★	★★★★	★★	★★	★★★★
Overall plot quality	★★★★	★★★★	★★	★★★★	★★★★

N/A = Not available ● = Yes ○ = No ★ = Fair ★★ = Good ★★★ = Very Good ★★★★ = Excellent PC — Indicates Editor's Choice.

EXPLANATION OF FEATURES: Plotters are categorized according to the **Maximum paper size** they can accommodate. Size A is 8½ by 11 inches, B is 11 by 17, C is 17 by 22, D is 24 by 36, and E is 36 by 48. **Paper movement** and **Paper hold system** are explained in the introduction to the reviews. **Number of pens** is self-explanatory. **Pens auto-capped** refers to automatic pen-capping capability, which is necessary to prevent drying of the pen tips. **Maximum pen speed** is the fastest speed (rates can vary depending on whether the pen is moving diagonally or along the x or y axis). Almost all plotters allow for **Adjustable pen speed**, but, while some let you specify any speed within their range, others can adjust speed only in fixed increments, which are sometimes set by switches rather than by software. **Step size** and **Accuracy** are the major determinants of a plotter's ability to create sharp and detailed plots.

Step size is measured in either the number of steps per inch or by a distance measurement. At least theoretically, the more steps per inch, the better the resolution. The measure of accuracy used here is the percentage of accuracy over a long pen move. **Buffer size** shows the amount of RAM built into the plotter itself for storing instructions. Some of the plotters tested let you add RAM to expand the buffer size. Some plotters allow digitizing by letting you move the pen head with cursor keys to a desired location, then send its position coordinates to the computer by hitting a key on the operator panel; hence the **Act as digitizer** entry. **Auto paper feed** indicates capability for producing a sequence of plots without manual intervention by using a batch process (the graphics software in use must also allow this; most business graphics and small CAD programs currently do not).

The interface section shows what type of interfaces are available or standard. Most personal computers use either **Serial RS-232** or **Parallel Centronics** interfaces. The **IEEE** interface, also known as **GPIB** (General Purpose Interface Bus) or **HP-IB** (Hewlett-Packard Interface Bus), is designed primarily for scientific and control applications.

The programming section lists graphics command languages. **HPGL**, the Hewlett-Packard Graphics Language, is emerging as a de facto standard. **Proprietary** indicates a manufacturer's own command set. **Other** indicates that a manufacturer chose to emulate a graphics language other than HPGL. **Bundled software** indicates whether any commercial graphics software is included with the plotter.

Subjective Evaluation of four key considerations reflects the opinion of contributing editor Glenn Hart.

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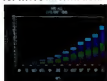


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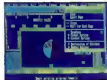
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Symphony - Lotus Development Corporation, Framework II - Ashton-Tate Inc., PC Print/Screen - Z-Soft Inc., IBM - International Business Machines Inc., Hercules - Hercules Computer Technology Inc.

■ NEW PLOTTERS



EDITOR'S CHOICE

Selecting an Editor's Choice from among these five ABC plotters was not at all easy. Each of the units evaluated has merit and all do a good job in one or more of their functions, though each suffers from some drawbacks as well. The joint winners in this review are the Hewlett-Packard ColorPro 7440 and the IBM 6180 twins. Both are manufactured by Hewlett-Packard and are essentially the same machine. They are very capable and produce lovely business presentation graphics. Considering that they produce only A-size plots, they are on the pricey side, but they offer eight pens instead of the two pens offered by the plotters they replace (for only \$150 more than those machines). Six-pen B-size plotters offered by both companies cost about \$600 more. If you need only A-size output, either the HP or IBM version of this machine will deliver reliable service for years to come.

Even using its parallel port and fiber-tip pens, the DPX-2000 was slower than other plotters with nominally lower speed ratings. The plotter automatically slows down another 6 to 9 percent with ceramic pens.

The DPX-2000 is a beautifully built, high-precision device with an excellent control panel, advanced pen handling, and, most important, superior output quality. It's also quite costly in a plotter market where good D- and even E-size plotters can be had for about the same price or perhaps even less, and it's definitely on the slow side.

I find the DPX-2000 an appealing device, but after weighing the evidence assembled by the Labs, you should check it out carefully yourself to see if its particular features meet your needs.

Glenn Hart is a contributing editor of PC Magazine.

Sudden AT[™] Death. What Would You Do?



You turn on your AT[™] computer and suddenly it starts to happen. Your computer starts gasping for information because your AT battery is dying. The simplest data, like the time and date, becomes a struggle. All vital signs start fading from the screen. Without action, the victim will soon lapse into unconsciousness.

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CIRCLE 269 ON READER SERVICE CARD

PC MAGAZINE ■ OCTOBER 14, 1986

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CIRCLE 170 ON READER SERVICE CARD

EASIER THAN DOS DEBUG: SIX UTILITIES FOR BYTE-LEVEL EDITING

Byte editors specialize in "unerasing" files, but their capabilities go further. They put the power normally reserved for professional programmers into the hands of nontechnical users.

You already possess one of the most powerful programs for probing memory and modifying disks. With DEBUG, which is included on the DOS supplemental disk, you can change any byte on any disk, recover erased files, disassemble programs to see how they work, and even watch programs execute one step at a time to find flaws or hidden secrets. The trouble is, DEBUG is primitive, cantankerous, and painful to use for routine chores. Although it can do nearly anything, you can spend the better part of a day getting the results you want.

For \$100 or less, you can buy one of several programs that do most of what DEBUG does (with the exception of disassembling programs) but do it better—or at least more easily. Using menus instead of DEBUG's commands, they offer dedicated procedures that put you in charge of every byte in your system. The best-known product in this category is *The Norton Utilities*, but many users don't realize that it isn't the only option. *Disk Toolkit*, *File Recovery System*, *PC Tools*, *Super Utility*, and *Disk Mechanic* offer similar capabilities. These utilities put the power normally reserved for professional programmers into the hands of nontechnical users.

At the heart of most of these programs is file recovery, the ability to resurrect files inadvertently or prematurely erased. DEBUG can effectively retrieve any file consigned to oblivion (see PC Lab Notes, PC

Magazine, Volume 5 Number 7), but only with great effort and confusion. The headaches you'll save by using a utility's file-recovery feature can easily be worth its price. The powers of these utilities go well beyond file recovery, however. They're called "byte editors" because they specialize in byte-level modification of the data on floppy and hard disks.

EDITING BYTES With all the byte editors reviewed here and with DEBUG, you can view and modify any byte anywhere on a disk. While word processors and text editors are limited to standard ASCII text files, byte editors can modify data whether or not it is in a file. For example, they can work with disk directories, boot records, a disk's file allocation table (FAT), or the inner workings of programs.

These capabilities may not sound useful to you, but once you've tried them you'll find them invaluable. For instance, you can change the text that commercial programs display to let you know what version of the program is running. I used a byte editor to add a message to the printing menu of each installation of my favorite word processor (I have several versions installed to handle a number of incompatible printers). Each time I boot up any version of the program, it tells me which printer driver it uses.

Byte editors can help you organize your disks by giving you the ability, often under menu control, to alter any aspect of the directory entry of a file or subdirectory and even automatically sort entries alphabetically or by date. You can change not only the name but the time and date stamps and the attributes of any file. Altering file attributes allows you to hide and/or write-protect individual files, a feature that can be invaluable if you share your PC with several other users. You'll never again worry about anyone's poking around in or erasing important files.

When you make an otherwise unfixable mistake, byte editing of directory entries can come to the rescue. Once, while cruising through BASIC, I accidentally created a file with an impossible name containing several graphic characters. (I don't know how I did it, and I've not been able to duplicate my efforts.) Not only did DOS refuse to erase the weird file—or even admit

that it existed—but the file prevented my backup system from working properly. I expunged the demon file from the disk using the disk-sector-modification abilities of a byte-level editor.

Byte editors are also valuable when you want to enter one of the short programs, modifications, or bug fixes that appear in *PC Magazine* without tangling with DEBUG. Modifications become much easier to perform under control of a full-screen editor.

Most byte editors have file- and disk-

■ When you make an otherwise unfixable mistake, byte editing of directory entries can come to the rescue.

searching abilities to help you find the bytes you want to edit. They compare a string of text or hexadecimal bytes you enter with disk information and tell you every time they find a match. For instance, you can search for every occurrence of the word *copyright* on a disk and find out who wrote the programs. Or you can use key words to find text that has been erased and separated from the rest of the erased file.

Byte editors often allow you to make lost information useful again by copying an individual sector of disk data into a new file. Two of the programs reviewed in this article, *Disk Mechanic* and *Disk Toolkit*, can even format individual disk tracks. Most byte editors allow you to test your disk drives themselves for bad sectors and other potential troubles. Some add the ability to find files that you've misplaced, usually because you've forgotten in which subdirectory you've stored them. *The Norton Utilities* includes a special program dedicated to that function.

EQUAL EFFECTIVENESS All six of the byte editors reviewed here handle their duties efficiently. They differ primarily in the combination of features that they offer

and the ease with which they allow you to carry out each function.

The file recovery features of all the programs are about equally effective. Those that automatically select and restore clusters, or just suggest clusters to restore, succeed and fail under exactly the same circumstances. A single erased file on a disk will be no problem for any of them; once a disk becomes scattered and several files are simultaneously blown away, however, recovery becomes chancy no matter what tool you use. You'll have to check every cluster to see if it contains any of your treasured text.

Nearly all of the file recovery functions give you some means of accepting or selecting the scattered clusters that you want to restore. With text files, you have a good chance of finding everything you need. With programs and nontext files, you may be out of luck.

The differences in the file recovery abilities of these packages amount to compatibility, flexibility, and ease of use. A couple of the programs are so painful to use that you might prefer losing your files to dealing with their arcane file-recovery functions.

All of today's "unercasing" utilities will work with all floppy disks. However, some of the utilities (for instance, the current version of Brown Bag Software's *File Recovery System*) may not work with some more unusual non-IBM hard disk systems. Some programs force you to go through the individual cluster-selection process no matter how trivial the recovery. Others give you the option of automatically digging up all the lost data of your wayward file or files using a single command.

In byte-level editing, as well as file recovery, convenience is the major issue. Some programs, such as *Disk Mechanic*, require that you deal with sector and cluster numbers; others isolate you from those inner workings of disks and DOS.

One of the best things about byte editors is their cost; the programs reviewed here range from \$39.95 (*PC Tools*) to \$100 (*The Norton Utilities*, Version 3.1). At these prices, you can afford more than one to get the most effective mix of features. I keep *The Norton Utilities*, *PC Tools*, and *Disk Mechanic* resident on my hard disk (in addition to using DOS DEBUG as the

need arises). By combining two or more programs, you can become master of every byte of data on your PC.

PC Tools

Central Point Software's *PC Tools* is one big program that simplifies almost any disk-oriented task, including recovering erased files, editing files or disk sectors, searching for data throughout a disk, changing file attributes, and graphically mapping disk usage. In addition, *PC Tools* duplicates most common DOS functions. It can be made memory resident, so you can call it up during another application to erase (or recover), copy, or display other files.

The program is completely menu driven. Your first choice is function. Then, with practically any function you choose, you must select the directory in which to work from a horizontal tree display. Or you can choose to work beneath DOS and attack the disk directly, changing things that DOS won't let you change.

The various functions of *PC Tools* are well integrated. For instance, you can search for data on a disk, then immediately

edit it. You can leap from sector to sector. *PC Tools* also gives you a second chance when you elect to make changes because it holds your changes in memory and only writes them to disk on your command.

You can use *PC Tools* to recover removed subdirectories, but only indirectly, by editing the directory the removed subdirectory was listed in. Files are recovered

PC
MAGAZINE

FACT FILE



PC Tools
Central Point Software Inc.
9700 SW Capitol Hwy.,
#100
Portland, OR 97219
(503) 244-5782
List Price's \$39.95

Requires: 192K RAM (256K for resident operation), one disk drive, DOS.

In Short: An inexpensive menu-driven, memory-resident program incorporating both DOS commands and DOS enhancements along with file recovery capabilities. Not copy protected.

PRICE: \$49.95/READER SERVICE CARD

one at a time, and you can choose between automatic and manual choice of the recovered clusters. For most DOS functions, however, files can be tagged to be automatically processed in bulk.

The byte editor function (which is called View/Edit on the menu) displays disk data in DEBUG format but adds a screen editor that is primarily controlled from the cursor pad.

PC Tools is among the easiest to use of the packages reviewed here. Although it lacks some of the features of *The Norton Utilities* and some of the power of *Disk Mechanic*, its memory-resident duplication of DOS functions makes it a worthwhile addition to any software library.

File Recovery System

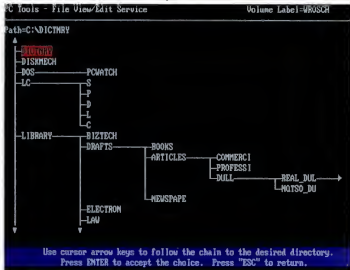
Brown Bag Software's *File Recovery System* also includes a disk snooping/editing (which it calls "browsing") system. The two programs share a copy-protected disk that must be run from drive A:

The entire package is menu driven, and the two programs, which are linked by a batch file, start from the same menu. On-line help makes the manual almost superfluous.

One overriding goal of the file recovery program appears to be data integrity: using the program requires step-by-step selection of the clusters to be included in the reconstituted file. The *File Recovery System's* recovery abilities go beyond most of the other programs reviewed here because it can extract data from damaged or non-DOS disks. (*Disk Mechanic* shares this ability, but *File Recovery System* is easier to use.) The software also permits you to recover removed directories indirectly using byte-editing tools and to give illegal names to files and directories.

Several menu choices address byte-editing functions, including altering file attributes, sorting directories, searching for lost data or files, displaying disk information and mapping disk usage, and viewing and editing bytes in files or in any sector on a disk.

Although the package is straightforward and quite easy to use, in its current form it is quirky. For instance, more often than not, the main menu dumps you back to a DOS prompt instead of loading the



To carry out any operation with Central Point Software's PC Tools, our Editor's Choice from the six byte editors reviewed, you must first select the directory to be used from this clear, concise, tree-structure directory display.

B1234567890ABCDEF	BYTE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
		Hexadecimal Display															
File	000	00	0A	20	09	28	09	28	09	28	09	30	49	6E	69	74	69
Initialization is	010	61	6C	69	74	61	69	6F	6E	28	69	73	28	64	69	76	
ided into two pa	020	69	64	65	64	28	69	6E	74	6F	28	74	77	6F	28	70	61
rts. File	030	72	74	73	2E	0A	0A	28	09	28	09	28	09	28	09	0D	0A
File	040	28	09	28	09	28	09	28	09	38	49	4E	49	54	5F	50	31
is overlaid by	050	28	69	73	28	6F	76	65	72	6C	61	69	64	28	62	79	28
the virtual disk	060	74	68	65	28	76	69	72	74	75	61	6C	28	64	69	73	68
buffer	070	28	62	75	66	66	65	72	0D	0A	28	09	28	09	28	09	28
File	080	09	0D	0A	28	09	28	09	28	09	28	09	38	49	4E	49	54
File	090	5F	50	31	28	69	73	28	65	78	65	63	75	74	65	64	28
first, then jump	0A0	66	69	72	73	74	2C	28	74	68	65	6E	28	6A	75	60	70
s to INIT.P2. I	0B0	73	28	74	6F	28	49	4E	49	54	5F	50	32	2E	28	28	49
INIT.P2 returns t	0C0	4E	49	54	5F	50	32	28	72	65	74	75	72	6E	73	28	74
caller. File	0D0	6F	28	63	61	6C	6C	65	72	2E	0D	0A	28	09	28	09	28
File	0E0	09	28	09	0D	0A	28	09	28	09	28	09	28	09	38	45	78
ercise caution i	0F0	65	72	63	69	73	65	28	63	61	75	74	69	6F	6E	28	69

Disk C: NON-standard, 05 sides, 0733 tracks, 17 sectors/track, 0512 byte sector
 ID:13M File:----- Side:0801 Sector:12 Logical:86947 PAGE 1
 (N)-Next (P)-Prior (R)-Read (S)-Screen (L)-Locate (X)-FrtSic (C)-Change Head
 (N)-Modify (Q)-Quote File name (H)-Help PgDn:Page Esc:Main Menu OPTION:

chosen utility. A DOS-formatted 30-megabyte hard disk that presented no problems for any of the other utilities here caused several error messages, including "FAT too big" and "Non-DOS disk." Nevertheless, the program performed all disk-editing functions with complete aplomb. With more development and attention to detail, these utilities could be useful and worthwhile.

As of this writing, Version 4.0 of the

File Recovery System was undergoing beta testing (it was scheduled for release in August). Not only have most of the bugs been squashed in the new version, but the structure of the program has been radically revised to make it even easier to use (the two separate programs have been combined into one), more powerful, and, thankfully, not copy protected. New features include automatic file recovery, disk- and file-wiping routines (which permanently erase data so that it cannot be recovered), and disk- and file-integrity checking.

Disk Mechanic

If you want to take intimate control of every aspect of your system, you'll want the power of Microsystems' *Disk Mechanic*. As its name implies, *Disk Mechanic* gives you the wherewithal to tinker with your disk drives and whatever media you can slide into them. In addition to recovering lost DOS files, you can probe, copy, and change almost any information on a floppy disk, whether it was put there by DOS or by some other operating system. You can analyze the sector structure of a floppy disk, make backup copies of most copy-protected disks, and even create your own copy-protection schemes. (Although *Disk Mechanic* itself was copy protected at one

All byte editors feature a double display of hexadecimal byte values (on the right-hand side of the screen here) and ASCII text equivalents. Through this display, you can change any value anywhere on a disk. Shown here is the Browse function of Brown Bag Software's File Recovery System.

time, current versions are not.)

Disk Mechanic is unusual in that it requires a BASIC interpreter to operate. IBM's BASICA, Microsoft's GWBASIC, and their equivalents work fine, though sometimes slowly. Once up and running, *Disk Mechanic* displays disk data by sector and searches for data on an individual-track basis.

Disk Mechanic can successfully change file attributes and erase and recover files, but it can be cumbersome to use. For instance, if more than one file has been erased from a disk, you must enter the track and sector number for each sector recovered. To change file attributes you must enter a code number (for instance, 32 for normal status) rather than make the menu selections required by other programs.

The trade-off for *Disk Mechanic*'s inconvenience is its power. Unlike most other utilities and all DOS functions, *Disk Mechanic* can get at data on damaged and non-DOS disks. If some hardware quirk wipes out the file allocation table of a valu-



FACT FILE



File Recovery System
 Brown Bag Software
 Software Resource
 Group Inc.
 2105 S. Bascom Ave.
 Campbell, CA 95008
 (800) 523-0764
 (800) 323-5335 (in
 Calif.)
 List Price: \$69.95 (Version 4.0, \$129.95)
 Requires: 128K RAM, one disk drive,
 DOS.
In Short: Menu-driven file recovery com-
 bined with powerful disk-drive manipulation
 and control functions. Can recover informa-
 tion from damaged disks. Copy protected
 (Version 4.0 is not copy protected).
 CIRCLE 000 ON READER SERVICE CARD



FACT FILE



Disk Mechanic
 Microsystems
 P.O. Box 285
 Framingham, MA 01701
 (617) 926-2055
 List Price: \$70
 Requires: 192K RAM,
 (256K on Compaq 64K
 more) if used with only one floppy disk
 drive), one disk drive, DOS 1.1 or later for
 some functions.
In Short: A DOS-independent program for
 file recovery and byte-level editing, as well as
 for duplication of nonstandard floppy disks,
 including many of those that are copy protec-
 ted. Although complex, it allows intimate
 control of nearly all aspects of disk-drive
 function. Not copy protected.
 CIRCLE 007 ON READER SERVICE CARD



Byte-Level Editors: Summary of Features

Product/ Manufacturer	Price	Unerasing Files		Directory recovery	Modify any byte on disk	Modify any byte in file	Attribute byte alteration	Search for data	Search for files	Sector mapping	Disk test	Works with non-DOS disks
		Automatic	Manual									
PC Tools Central Point Software Inc.	\$39.95	●	●	●	●	●	●	●	●	●	○	●†
File Recovery System Brown Bag Software	\$69.95*	●	●	●	●	●	●	●	●	●	●	●
Disk Mechanic Microsystems	\$70	●floppy	●‡	○	●‡	●‡	●‡	●‡	●‡	○	●‡	●‡
Disk Toolkit Morgan Computing Co.	\$75	●	●	●	●	●	●	●	●	●	●	○
Super Utility Breeze/QSD Inc.	\$89.95	●	●	○	●	●	●	●	●	○	●	○
The Norton Utilities 3.1 Peter Norton Computing	\$100 (update, \$25)	●	●	●	●	●	●	●	●	●	●	○

*Version 4 available August 1, 1986; \$129.95. †Only for disk-related tasks. ‡Floppy only. ●—Yes ○—No

able disk, *Disk Mechanic* will nevertheless let you pry the data in surviving sectors off the disk. Other programs will inform you of the damage and go no further.

If you don't like dealing at such a nuts-and-bolts level, you won't want to deal with *Disk Mechanic*. However, if you're a tinkerer at heart, you will wallow happily in its power.

Disk Toolkit

Morgan Computing Co.'s *Disk Toolkit* is the perfect program for speed demons who want a more flexible way to wield DEBUG's power. This amazingly compact

program packs into only 24K bytes all the editing power of DEBUG (except its ability to disassemble programs and run them one step at a time). It adds menu control and a full-screen editor for byte-level manipulations.

Some of *Disk Toolkit*'s pieces don't look as pretty as comparable parts of bigger and more-sophisticated programs. For instance, its mapping function merely lists the location of the sectors used by a file rather than graphically showing them.

Disk Toolkit's menu choices look a bit complex, mostly because they are carryovers from the terminology used by DEBUG, but using the program is a breeze, in part because it's fast. It performs functions almost instantly.

Disk Toolkit permits you to view, edit, and copy on the file and sector levels, as well as to peer into memory, rattling bytes around and copying them to disk. The display is much like that of DEBUG—multiple 16-column rows of hexadecimal bytes on the left with the corresponding ASCII representation on the right—but you can move around easily using the cursor-movement keys in the cursor keypad instead of lumbering along with DEBUG's single-letter commands.

A complete extended directory display also serves as a front-end for *Disk Toolkit*'s file recovery system. It displays all directory entries, whether valid, erased, or removed. To recover a file you select the

proper entry, give a new first letter to the file or directory name, and let *Disk Toolkit* automatically select clusters. Prompted manual cluster selection is also possible.

Disk Toolkit also allows you to check the integrity of a disk and verify that all storage areas are undamaged.

Super Utility

Breeze/QSD's *Super Utility* is a single program that incorporates several functions, including altering directory entries, editing disk sectors, recovering erased files and removed directories, copying and verifying disk sectors, and a crude version of disk mapping. This program has fewer features than any of its competitors, but the features



FACT FILE



Disk Toolkit
Morgan Computing Co.
P.O. Box 112730
Carrollton, TX 75011
(214) 245-4763
List Price: \$75
Requires: 128K RAM,
one disk drive, DOS 2.1
or later.

In Short: A quick-working, compact program that offers menu-driven file recovery, byte-level editing, and intimate system control. Also includes a full screen FAT editor. Not copy protected.

CIRCLE 69 ON READER SERVICE CARD



FACT FILE



Super Utility
Breeze/QSD Inc.
PowerSOFT Products
17060 Dallas Pkwy.
Dallas, TX 75248
(214) 733-4475
List Price: \$89.95
Requires: 128K RAM,
one disk drive, DOS 2.0 or later.

In Short: A file recovery system and byte-level editor with additional features. Not copy protected.

CIRCLE 65 ON READER SERVICE CARD

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WHICH CUSTOMERS BOUGHT MORE FURNITURE THAN AVERAGE IN THE LAST 6 MONTHS.

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on the screen. Then, with only two more keystrokes you're ready to enter information. Q&A moves between modules and features with simple menus. You can enter or retrieve information with plain English. And even though it's easy, one look at the box below will tell you that Q&A has plenty of power. So you won't outgrow it as your documents and databases become more sophisticated.

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Q&A is the "Editor's Choice" of PC Magazine's prestigious PC Test Labs. InfoWorld awarded Q&A 5 Disks, their highest rating... but the real testament to Q&A's value comes from business people who tried it, and now can't get along without it.**

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■ BYTE EDITORS

it does have work fine and may be all you need.

The primary program interface is a full-screen enhanced directory that includes a clear listing of all information found on the disk, including erased files, removed sub-directories, and all file attributes. Erased files and removed directories are indicated by an on-screen flashing descriptor.

File recovery is simple: after you type in a new first character to replace the one missing from the deleted file or directory, *Super Utility* begins to look for clusters one by one. You have a chance to examine the suggested cluster and approve the choice before it is added to the list of those recovered clusters.

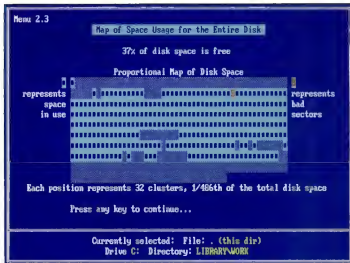
Disk sectors and files can be verified for their integrity (and your reassurance). To check disk sectors, however, you must type in the sector range, but the program offers no guidance at this point as to allowable ranges; it merely treats as an error any venture that goes too far. Like *DE-BUG*, *Super Utility* allows you to copy the information in one or more sectors into a new disk file so that you can later access it with a word processor or editor.

Changing attributes, time and date stamps, and file and directory names is as easy as typing the new information over the old. The latest version of *Super Utility* even allows you to erase a file or remove a directory by typing over the first character of its name with a space.

Super Utility allows you to edit any byte on a disk. In keeping with the structure of the program, editing is simply a matter of overtyping after zeroing in on the proper byte using the cursor-movement keys. Changes are immediately written to disk.

A few flaws mar *Super Utility*'s basically elegant design. The disk-mapping function is virtually useless. Its display of disk usage amounts to a text bar chart with ten increments that reveal no information about how scattered the files on the disk may be.

The program artificially limits pathnames to 58 characters. Its handling of not-ready floppy disks is rather ungraceful: it stalls without presenting an error message. However, the program does not jam, and you can switch back to another drive without the inconvenience of making the drive in question actually ready.



The Norton Utilities provides the clearest, most informative graphic map of actual disk usage. For any DOS-compatible disk, the map illustrates used and unused disk space and shows bad sectors.

The Norton Utilities

The Norton Utilities was the original DOS enhancement, and it earned its reputation with its file recovery abilities. Over the years, its author, Peter Norton, has increased the program's support for non-IBM hard disks and has added an increasing variety of functions with ever-greater depth. Today, *The Norton Utilities* works on virtually any disk—floppy, hard, or even virtual disks in RAM—and probably includes more functions than any other DOS-enhancement package.

The heart of *The Norton Utilities* is a program called Norton that has two basic functions: file recovery and byte-level editing. Erased sectors in a file being recovered can be gathered automatically or manually. The byte editor will dig into any file, directory, or disk sector and display the information it contains in each of three formats. It will display a full sector in hexadecimal and ASCII characters on a single screen. The editor is screen-oriented, using the cursor keypad to move through the data and displaying the byte offset of the cursor continuously so that you know exactly where you are in a sec-



FACT FILE

The Norton Utilities, Version 3.1
Peter Norton Computing
2210 Wilshire Blvd.,
#186
Santa Monica, CA
90403
(213) 826-8032

List Price: \$100; update, \$25
Requires: 128K RAM, one disk drive, DOS 2.0 or later.

In Short: DOS-enhancement utilities, including two file programs, directory recovery, byte-level editing, disk searches, file-attribute altering, performance testing, security-level disk erasing, and many convenience features. Not copy protected.

CIRCLE 884 ON READER SERVICE CARD

tor. Norton also graphically displays the cluster allocation for each file or disk.

A series of menus controls the Norton program. Unlike earlier versions, the current release (3.1) defaults to the selections required for file recovery, so you need only press Enter to dredge up dead data.

You know I can rescue your data.

The Norton Utilities' file recovery features are augmented by two new stand-alone programs, QKUNERAS and UNRMDIR. The former recovers a series of erased files with a minimum of fuss, providing none of their cluster assignments are ambiguous. The latter utility recovers inadvertently removed directories.

The Norton Utilities package also in-



EDITOR'S
CHOICE

All six utility packages are successful at the two basic tasks they claim to perform—file recovery and byte editing—but Central Point Software's PC Tools features several winning advantages. It offers ease of use without sacrificing power, and its extra features add value: the DOS interface is convenient, and the memory-resident option can work miracles if you get into trouble in the middle of an application—as long as your system has enough memory. On top of all this, PC Tools sports the lowest price tag of the lot.

There's no reason to look beyond PC Tools unless you need additional features, but if you do, look to The Norton Utilities or Microsystems' Disk Mechanic. The Norton Utilities offers the widest array of general features, while Disk Mechanic is notable for its special utility to handle non-DOS disks.

cludes dedicated programs to change the attribute byte of a file and the volume label of a disk. Because the utilities stand alone, they can execute quickly without waiting for the main program to load.

Other programs in The Norton Utilities package will obliterate data from files or disks so that it cannot be recovered, search for text or data strings, determine system origin, and evaluate disk integrity.

Fast, powerful, and easy to use, The Norton Utilities remains an excellent all-around choice for DOS enhancement.

Winn L. Rosch is a contributing editor of PC Magazine.

It's no secret. Thousands of business and home users have used my Norton Utilities™ software to restore precious data erased or deleted by accident. Mr. Kriley of Los Angeles lost his thesis and found it using my UnErase™ feature. He writes: "I owe my degree to Peter Norton." Computer pundit Jim Seymour says "Norton has saved my posterior with UnErase so many times—it's



A life saver for your data.

wonderful, Peter!"

UnErase is a powerful utility that lets you systematically search for lost data and retrieve it with a few simple commands. It makes The Norton Utilities the highly acclaimed industry standard for data recovery.

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tories, File Find and Text Search. File Attribute marks specific files

so they cannot be altered or erased. Wipe File deletes data by file. Wipe Disk clears your entire disk.

Other utilities measure available file space, test your disk for damage, and measure your computer's performance. PC Magazine calls The Utilities "Indispensable." The New York Times says "Don't compute without it." Peter McWilliams (The Personal Computer Book) says "You'll bless this disk." Dozens of features keep your data in line. Every day.



The Norton Utilities™ and UnErase™ are trademarks of Peter Norton Computing, Inc. © 1986 Peter Norton Computing. IBM® is a registered trademark of International Business Machines Corporation.

The Norton Utilities. Designed for the IBM® PC, PC-AT, and DOS compatibles. Available at Computerland and most software dealers. Order direct for \$99.95 from Peter Norton Computing, Inc., 2210 Wilshire Boulevard, Santa Monica, CA 90403. 213-453-2361. Visa and Mastercard welcome.

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And why shouldn't we be? If "the business of America is business," as Calvin Coolidge observed, management is the calling and the skill that makes it possible. Even that darling of the eighties, marketing, would be nowhere without management. Good management is to be encouraged. And whatever helps create more good management should be embraced.

Now, on top of college degrees, associations, seminars, books, on-the-job training, fads, and bromides, you can learn management from business simulation programs on your PC. Or so claim the companies that publish these simulations.

■ BUSINESS SIMULATION

SIMULATING BUSINESS Simulations are not exactly a new concept. Most of us played board-game-type simulations like Monopoly or Risk as children. PC-based simulation software like Microsoft's *Flight Simulator* and Xor's *NFL Challenge* have been around for several years now. At the very least, we've all prepared for meetings or telephone conversations by mentally creating—simulating—scenarios. The three business simulation programs examined here allow you to test business-related management decisions against an economic model of the real world. Each simulation encourages you to analyze a particular business situation, create a strategy, and take risks.

All three have similar features and follow the same general scenario. As the player cast as CEO, you're charged with either turning the fictitious company around or increasing its efficiency and profitability. The number of players and the nature of the market competition vary. For each turn of play, you are required to make decisions that affect your company's overall financial health.

A typical turn can consist of as many as five steps: analyzing the current situation, making a preliminary decision, testing your decision, making the final decision, and advancing the time frame. For example, you can read the departmental memos and industrywide newspaper before viewing any graphs, which display such information as revenue history, market share, and financial makeup.

Based upon your analysis of the economic situation, your company's financial health, and business strategy—high-profit margin with heavy R&D or heavy advertising, low profits, and high revenues—you enter such decisions as how much to spend on advertising and where to set product price. You note the effects your decisions have on your model, perform a sensitivity analysis by changing one piece of input, and observe how that change affects your revenues, cash flow, and net profit. If necessary you rethink your decision. Finally, you advance the time frame.

The simulation program processes your data and gives you new results. You repeat the entire cycle until the simulation ends. A session can take as little as 2 hours or much longer, depending on the game and

how long you take to make decisions. As in the real world, game success is measured over a period of time and by a combination of profit, stock performance, and market share.

LEARNING MANAGEMENT The goal of these simulations is to teach business concepts and, as much as possible, decision making. You can generally run the simulation more than once and continue to learn. This is especially true if the program has an environment editor so that you can change certain variables within the model and save particular features of a game.

■ Simulations are not a new concept. Most of us have played Monopoly or Risk as children.

This allows you to return to a specific point in the simulation and rerun it with different decisions.

Ultimately, you absorb the broad concepts that these simulations teach and, presumably, acquire high-level management experience. It may be ersatz experience, but, if the concepts are valid, it's better than no experience at all.

My own experience confirms these claims, at least when using *The Strategic Management Game Corporate Edition*, a simulation provided by the publisher as a service rather than as a retail product (see sidebar "PC Magazine Event: The Survival of the Richest"). First, business simulations can be fun and entertaining, as well as educational. Second, to participants, a good simulation becomes the real world, at least for the duration of the simulation. Third, the amount of useful management experience gained from a business simulation depends on the level of experience of the player. Real-life CEOs aren't likely to find simulations a productive way to improve their skills, though they may enjoy them as a pastime. Students, the generally ambitious, and aspiring CEOs are likely to find them worthwhile.

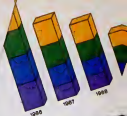
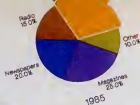
REALISM? In any case, no business simulation is totally realistic; it cannot factor in every variable that may affect an outcome. Any business simulation is only as effective as its mathematical model of relationships between variables and the accuracy of the model's data set. If either is wrong, the simulation will produce misleading results.

Business simulation programs should be judged by their verisimilitude (how closely they mimic real-world conditions) and by their ability to define and reuse variables within a corporate or market environment. A good simulation program will allow you to acquire historical data, study its strategies against other conditions, confront new problems, and learn new solutions. While it's certainly possible to design your own simulation by creating a financial model with a sophisticated spreadsheet program and a market environment with a specialized simulation language like Pritsker's and Associates' SLAM II, you will probably find the effort isn't worth the result. The virtue of the programs reviewed below is that they're ready to boot up, straight from the box.

The American Dream

Blue Chip Software is hardly a new name in the simulation market. Its vertical market simulations for the real estate and banking industries have been around for a while and are well regarded. The company's general business simulation, *The American Dream*, is aimed at lower- and middle-level managers who need to broaden their understanding of the internal working relationships among corporate departments.

EIGHT DEPARTMENTS In *The American Dream*, you are responsible for eight departments: finance, research and development, engineering, materials control, manufacturing, production, quality control, and marketing and advertising. During the course of the simulation, these departments inundate you with memos requesting more money and keeping you posted on inventory levels, production schedules, and the effects of your recent decisions. Mimicking real life, many of these reports overlap, further congesting the decision-making process. By coordi-



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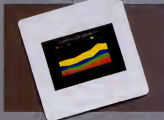
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■ BUSINESS SIMULATION

nating and balancing their requests with the company's goals, you attempt to replace chaos with efficiency and order.

Because *The American Dream's* focus is to balance departmental requests and needs against companywide goals rather than to compete against other companies, the competition is never directly addressed. You are told only the average cost of its products and, by implication, its market share. As a result, instead of poring over your competitors' strategies and formulating your own, you concentrate on your organization.

TOUGH ENVIRONMENT Unlike the other simulations reviewed, *The American Dream* does not allow you to take the initiative, drive the market, and still make a 30 percent profit or more. If you continuously pump money into advertising, plant expansion, and research and development—areas that should increase market share and profit—you will soon find yourself overdrawn at the bank. However, if you keep your costs and inventory levels low, advertise moderately, and maintain relatively high quality control and R&D expenditures, you will increase your revenues and, one hopes, your profit.

The American Dream's environment affects profitability to a greater degree than those of the other simulations. Increased advertising may cause a small increase in sales, but an overlarge inventory will erode the margin to nothing. You can emp-

ty your company's coffers on market research and sales promotion and receive little, if anything, in return. Even something as simple as searching for a less-costly supplier may not affect anything other than your bank account. These factors make *The American Dream* somewhat more realistic than the other simulators.

BAD TRAINING Unfortunately, the constant shifting of the economic winds within the program causes it to fail somewhat as a training tool. In real life, fortune is not as fickle as *The American Dream* makes it out to be (if it were, there would be no point in learning management). You do not want a simulation to fluctuate like an elevator in the World Trade Center. You are not learning anything helpful if you need to hire and fire a national sales force every few months or open and close factories in order to maintain a high profit margin—but you must to succeed in this simulation.

At times it seems as though the simulation encourages bad management practices. For example, after a few sessions, you realize you can largely ignore most departments because they have their own momentum. In real life, you grant and withdraw departmental autonomy, but you always keep yourself informed. The program also seems to teach that suppliers who cut you off for late payment will still deliver the material the following month.

Although *The American Dream* comes with an environment editor that allows you to customize up to 45 variables, only a third of them affect the model in such areas as interest rate and wages. The rest—names of department heads, default Boolean settings—are window dressing. According to a spokesman, there are actually over 150 variables in the simulation.

As a program, *The American Dream* has few deficiencies other than its interface, which forces you to enter more keystrokes than should be necessary. The separation of departments may be realistic, but its implementation as separate menu choices is inconvenient. Combining some of the departments—like quality control and manufacturing—under one menu would ease frustration. On-line help would be better situated within the screens rather than in the main menu.

Despite the problems with *The American Dream*, it is absorbing. When played conservatively, it can teach basic concepts about interdepartmental relationships. However, as it is currently designed, the thrill wears off after several sessions; the program soon becomes an exercise in hitting the keys. If Blue Chip ever decides to supply a full environment editor and one or two preserved games with the program, it would be a much better training tool.

Venture's Business Simulator

Venture's Business Simulator appears to be the result of a lot of research and development and insufficient quality control and market research. Distributed by Electronic Arts (a software game house), *Business Simulator* is the slickest of the programs I reviewed and also the buggiest. According to its developers, it is an individualized version of *The Strategic Management Game*. While the environments and scenarios are somewhat similar, *Business Simulator* includes graphics and a variety of on-line help for running the program and for making business decisions.

START-UP Primarily geared to middle- and upper-level managers such as division heads and directors of finance, *Business Simulator* puts you in control of a start-up that manufactures and markets up to three types of robots. Your job, as the user, is to turn it into a multinational corporation.



FACT FILE



The American Dream
Blue Chip Software
6744 Elton Ave.
Canoga Park, CA 91303
(818) 346-0730
List Price: \$124.95
Requires: 256K RAM,
one disk drive, DOS 2.0.

In Short: *The American Dream* is targeted at lower- and middle-level managers who need to broaden their understanding of corporate organization. Copy protected. (This program, priced at \$59.95, is now available as *Managing for Success: The General Management Simulation*.)

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FACT FILE



Venture's Business Simulator
Electronic Arts
1820 Gateway Dr.
San Mateo, CA 94404
(415) 571-7171
List Price: \$99.95
Requires: 256K RAM,
two disk drives, DOS 2.0 or later.

In Short: *Venture's Business Simulator* should perhaps be called *Business Simulator*, for it is riveting. An irritating buginess and the absence of certain features leave room for improvement. Not copy protected.

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PC MAGAZINE EVENT: THE SURVIVAL OF THE RICHEST

Last June, PC Magazine joined with corporate training consultant MicroTrek and teams of number-crunching hotshots from AT&T, American Express, and TPF&C to see just how far a business simulation could go.

Can business simulation software help executives acquire better management skills? That was the issue at stake in *Survival of the Richest*, a business simulation contest cosponsored by PC Magazine and MicroTrek, a leading consultant and training company. The monthlong event culminated in a day-long corporate brainstorming session on June 12, 1986, at New York's Parker Meriden Hotel.

The idea behind the contest was simple. Teams from three companies, AT&T, American Express, and compensation and actuarial consulting giant Towers, Perrin, Forster & Crosby (TPF&C) participated in a business simulation in which they managed fictitious companies that developed, produced, and marketed a hypothetical consumer product. A fictitious Japanese team, staffed by the Strategic Management Group (SMG, which publishes and markets the simulation used in the event) added a surprise variable that served, in effect, as a control team. The simulation, *The Strategic Management Game Corporate Edition*, is designed to train middle managers and business students.

Each team took a fictitious name for its company. Before the three teams met at a breakfast meeting at the Meriden, none of the contestants knew which pseudonym represented what company. American Express Travel Related Services Co., represented by Brian Lavelle, manager of microcomputers, took the name XYZ Corp. AT&T's team, manned by Charles Redmond II, division manager of marketing communications; David Gigante, district manager of business analysis for workstation products; and Fred Bondlow, department chief of financial planning and sales support for major account sales, competed as Safari

Corp. TPF&C's team included consultants Michael L. Davis, Frank A. Robert, Katherine F. Rosen, and Jay R. Sibel and took the name MBI, an acronym that more than one contestant suspected was actually an anagram for a major manufacturer of personal computers.

PLAYING TO WIN From the beginning, the teams played to win. Their competitiveness may have had something to do with the prizes, a Tandy 200 laptop computer to be given by PC Magazine to each member of the winning team. Also pressing them on, however, was corporate and individual pride. "As long as we're in this thing," said AT&T's Gigante, "we might as well do everything we can to win it."

Thus motivated, the team members who came to the Parker Meriden came to play hardball. In each team's hotel suite, the contestants pored over spreadsheet models, studied *The Survival of the Rich Journal* (a *Wall Street Journal* lookalike produced on the game's "yearly" calendar to keep the contestants up on important information), and hammered out key business strategies. By midmorning, there wasn't a dry brow, unloosened tie, or unrolled-up sleeve in the house.

The three real teams (excluding the SMG-fronted Japanese team, Destiny Inc.) began the game as start-ups, each with about \$20 million in venture capital, a factory, and equal shares in a single regional market for a single product. Teams make decisions on a yearly basis



"Survival of the Richest." The winning management team of *The Survival of the Richest* business simulation competition sponsored by PC Magazine and MicroTrek in New York. As the high-flying Safari Corp. officers (right to left around table: AT&T's David Gigante, Fred Bondlow, and Charles Redmond II) debate the finer points of corporate strategy, Bill Ortel from AT&T's Technical Support pores over numbers generated by the team's Advanced VisiCalc model. The event demonstrated that sophisticated simulation programs like *The Strategic Management Game Corporate Edition* are an impressive training option for managers, aspiring managers, and future CEOs.

over a 4-year period; while crises can and do occur, the game's emphasis is primarily on medium- to long-term strategy and positioning.

The game covers all aspects of starting a company, building market share, managing debt/equity ratios, building for the future with R&D expenditure, and coordinating production capacity with anticipated demand. Factories depreciate, markets grow, inventory builds and costs money to maintain, loans mature, underpaid workers strike, loan sharks break delinquent debtors' legs—the game is rich in the detail and capacity for randomness that make real-life business challenging and exciting.

Several options are built into the game. Companies may expand their markets regionally into the western United States or Canada, or by product line from standard into premium and superpremium. How they perform is largely a function of how and where they spend their money. For instance, a large advertising budget will usually increase market share; hefty payrolls increase worker satisfaction. If manufacturing staffs work harder, productivity rises. On the other hand, you can sink huge amounts of capital into advertising, R&D, and plant staff, enjoy a dominant market share, and produce the highest profit, and still go bankrupt if your profits are too low or cash is too hard to come by.

DEALING WITH CRISES *The Strategic Management Game Corporate Edition* re-creates the real financial world to the extent that any decision made by a team affects every other team's subsequent performance. In fact, the real-world feel of the game can be frightening. As companies exceed a debt ceiling determined by their asset and income levels, the banks turn their debts over to a collection agency, a person of suspect reputation known as Big Al. A news item in the December 31, 1986, issue of *The Journal* screamed, "Big Al does big business, loans XYZ and MBI \$2.9 million and \$3.9 million respectively!!... Al's limo reported lurking in Parker Meriden garage." Such is the

stuff that sends stock prices plunging and executives to their Maalox.

In order to be successful, team members have to quickly grasp company, market, and economic details and spin from them the big picture. This is where the PC played a crucial, though not necessarily deciding, role in the contest.

Michael Wilding of MicroTrek attributed this to the "garbage-in-garbage-out" (GIGO) syndrome that is well known to MIS managers. Not even the best program can be any better than the data you feed into it. Since there is little hard data to go on in a start-up situation, managers are forced to rely on their business sense and instincts. Wilding predicts that computers can never become more than an adjunct to the managers they support. "The techno-manager of the future still needs that subjective side," he said. In the long run, subjective appraisals and decisions were what won the day (or days) for the most successful (measured in dollars and cents) team.

TEAM STRATEGIES The teams' analyses were particularly revealing of the human side of human/PC interaction. XYZ Corp. based its strategy on three tenets: early market presence in each region, emphasis on the upscale side of the market, and cost control. Its 1-2-3 models were focused on marketing potential and company finances.

According to Charles Redmond, the primary goal of Safari Corp. (AT&T) was simply "to be the most profitable." Redmond outlined a two-stage "yuppie growth strategy": First, establish market presence at the low end by cutting prices and distributing widely; second, ratchet upward into the high-margin superpremium market. Running *Advanced VisiCalc* on an AT&T 6300 Plus, Safari's modeling was the most extensive of the three teams, covering many aspects of the market and the company's finances.

Destiny Corp. inched in with what SMG's Andy Lipitz characterized as a "typical Japanese market strategy," focused on long-term domination of the marketplace rather than short-term profits for shareholders. It plotted strategy us-

ing the built-in planning facilities of *The Strategic Management Game* itself.

TPF&C adopted the role of a fast follower: make sure competitors do not go unchallenged in any market area, spend freely on advertising and R&D to retain high quality and hefty market share, and set prices in the medium range in each category. The professional consultants on the TPF&C team used *Symphony's* spreadsheet to guide them through the mathematics, and its outlining function helped them clarify their thinking.

Through the first 3 simulated years of the competition, the teams ran surprisingly even. With high prices and a low ad budget, XYZ Corp. ran into problems selling its product. As a result, debt quickly outstripped income, and it went into the fourth year with inflated inventories and a negative balance sheet.

MBI Corp. also maintained high debts but sold plenty of product at a good margin. The company also suffered cash-flow problems, mainly because of underproduction; by the third year, back orders had grown to about \$500,000, which, according to a fixed formula in the game, cost the company sales in a multiple of four times back orders, or \$2 million. MBI's strategic flaw was that it stayed at two factory shifts, while its competitors were going to three. Market share and total market size grew, while MBI continued to produce at former levels.

The Japanese dummy company, Destiny, seemed to have a successful strategy. With the lowest prices in the market and high production capacity, profits stayed low, but it had plenty of sales and cash. Misfortune struck when the U. S. Commerce Department decided that Destiny's success was "not in the best interests of the American economy," and the company was "forced to voluntarily" limit production and imports.

THE WINNER IS... The winner? Safari Corp. In the final tally, AT&T won because of a synergy between sound positioning and management, and a watchful eye on the numbers. It ended up with high profits, the best debt/equity ratio, the highest stock prices, and the

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BUSINESS SIMULATION

("The Survival of the Richest" continued)

highest net gain in stock price.

The other winner was the PC, which proved itself a top-notch decision-making tool. None of the competitors felt that they would have been able to make the kinds of quick, data-dependent, analysis-rich, if ultimately subjective, decisions required of them had they not had access to PCs. Somewhat ironic suggestions to the contrary were consistently met with incredulity that bordered on disdain. A personal computer is not in and of itself a good manager, but the notion that computers help managers become smarter is no longer open to question. After a grueling month simulating CEO reality, we no longer question the validity of SMG's approach to management training.

—Paul M. Stafford

MicroTrek, cosponsor of Survival of the Richest, is a New York-based consulting and training company. According to Paul Goldner, MicroTrek president, "the synergistic use of the personal computer achieved in The Strategic Management Game is representative of the approach we take to training executives in our seminar programs." MicroTrek's address is 60 E. 42nd St., #937, New York, NY 10165, (212) 286-0894.



FACT FILE



The Strategic Management Game Corporate Edition
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(215) 387-4000

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In Short: SMG's *The Strategic Management Game* is a sophisticated training tool that teaches skills in business through simulated experience. It is available as part of SMG's business simulation seminars and through corporate site licensing.

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THE BUSINESS JOURNAL Survey of Company Balance Sheets											December 31, 1996	
	CASH+	REC+	INVEN	FIXED	TOTAL	LOANS+	PAY+	DEBT+	EQUITY			
Reality D	2846	963	1052	8025	12886	0	708	7000	5178			
Texas Ins	1940	1010	2543	10947	16440	0	890	8995	15555			
Hewlett-P	3316	377	2855	6335	12883	0	615	7116	6752			
Tandy Cor	4904	1114	2152	10009	18033	0	343	9811	2335			
Apple Com	5319	340	1363	5530	12552	0	443	7482	4627			
--% CHANGE 1995 TO 1996--												
Reality D	4	25	170	12	16	0	43	0	44			
Texas Ins	-51	25	56	12	30	0	58	16	51			
Hewlett-P	141	25	118	-13	25	0	16	15	15			
Tandy Cor	126	33	47	-16	15	0	36	3	23			
Apple Com	111	9	-51	-13	5	0	-22	3	10			
List of Available Options												
[Esc] - Return to Menu	[F4] - Next Section	[Alt] Analysis Mode										
[F1] - Print Screen	[F6] - Previous Section	[Alt] Tutorial Mode										

This screen from Venture's Business Simulator shows imaginary historical data from a simulation set in the future. Players have access to and evaluate such screens (others include annual reports for each company, corporate bond reports, and industry statistics) before making key decisions affecting the position of their company. Note that you can detect trends by studying the bottom half of the screen (under the heading "% Change 1995 to 1996"), which displays the variance from one year to another. Also note the Analysis and Tutorial options at the very bottom of the screen.

The 7-year simulation takes you through five stages. Each level—start, growth, independence, new products, and new markets—adds complexity in the form of more decisions. The decisions you need to make cover production levels and factory expansion, product pricing and advertising cost, and the size and type of your sales force.

Five companies, two of which can be human players (the simulation manages the other three), compete in the market. The computer-controlled competitors are modeled after well-established corporations: Apple, Texas Instruments, Hewlett-Packard, and Tandy. Their game plans are similar to strategies actually employed by these companies. HP, for example, goes after the high profit margin, Apple reinvests its earnings in R&D, and Tandy attempts to corner market share.

Everyone begins at the same level, with a net worth of \$50,000, no factories, no sales force, one product, and presence in only one geographical area. Your initial decisions are limited to the number of robots to purchase, how much to spend on

your advertising campaign, and the amount of money to borrow. If your company's worth increases enough, you rise to the next level. Eventually, you need to decide whether to float bonds or issue stock, expand into new territories, and introduce new products. At any point during the simulation, you can go bankrupt, end up borrowing from a loan shark, or fail to reach the next level.

SLOW SPEED As a simulation, *Business Simulator's* processing speed and the absence of an environment editor hamper its effectiveness. The former leads to impatience and the latter to frustration. Electronic Arts should at least consider replacing the program's "processing decisions" message with the stock-price graph that begins each turn.

While this will not actually accelerate the processing, it will give the appearance of action. The addition of an environment editor would enable you to enter economic data that more closely mirrors reality, as well as allow you to create scenarios that

Interlude II

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■ BUSINESS SIMULATION

reflect your specific business needs.

Even as a training tool, *Business Simulator* falls short. Its consulting mode tends to be generalized and of little use until you have run the simulation a number of times. Also, the manual glosses over strategies and offers no specifics about the game's operations. For example, it would be nice to know at what point advertising spending and sales-force size cease to have an effect.

Some of the program's other problems are easily remedied. For example, the manual, which mentions a share buy-back feature, fails to explain the actual process. Also, the program itself should display legal ranges prior to input rather than have the range pop up as an error message. Non-game-related error messages should be more helpful. If I, a professional reviewer, don't know what a "-2957 Trouble with the Graphics Module" message means, how can a manager whose computer experience is limited to spreadsheets possibly know?

BUGS More troublesome are the errors that imply problems within the simulation itself. On a number of occasions, companies with a negative net worth appeared at the top of the heap. (This may be a problem of assigning the internal value as an integer rather than a real number.) And every so often, you may find an improperly balanced balance sheet, especially if you have a negative equity.

Despite its problems and bugs, there is something compelling about *Business Simulator*. What's more, it does provide a model that approximates reality. It may not have all of the features you want or need, it may not trap every error, but it is undeniably riveting.

Free Enterprise

Free Enterprise is an example of what happens to a product when its research and development funding dries up. Originally developed on a mainframe as the *IBM Management Decision-Making Laboratory* in 1963, *Free Enterprise* was released by Science Research Associates (an IBM subsidiary) in 1982 for the IBM PC. At that time *Free Enterprise* was state of the art, requiring only 64K bytes of RAM, BASIC, and DOS 1.0 to operate.

Free Enterprise is less ambitious than the other simulations in this article in that it is targeted at the novice in corporate finance, allowing three levels of play: beginner, intermediate, and advanced. The higher the level, the more decisions you are required to make. At the lowest level, you input the product price and the advertising costs. As an intermediate player, you are also called on to decide how much to spend on production, plant improvements, and research and development. The advanced level adds decisions related to borrowing and repaying capital and paying out dividends. Each turn in the game simulates 3 months of operations.

To aid your position as CEO, there are three industrywide reports and five corporate reports. The former supply information on stock fluctuations, earnings per share, and cumulative industry data. The confidential corporate reports include area sales analysis, the production report, the profit and loss report, the sources and uses of cash statements, and a balance sheet.

SIX PLAYERS Up to six companies—headed by any combination of human or program-driven players—can

compete in up to seven geographical areas. Each company controls a home area in which it is firmly entrenched and has access to a common market area. Besides the advantage of product recognition, in the home area you have little or no cost for transportation.

When the computer is one of the players, you can set its company strategy to one of three orientations. For example, if your normal business is growth oriented, both you and your program competitor can gear production, R&D, and development for long-range growth goals. If you prefer to do battle with a marketing-oriented competitor, the program can be set to model an aggressive, low-profit company in search of larger market share. You can set the program to mirror a balanced competitor, one that plays conservatively and attempts to follow your lead. You can also have *Free Enterprise* choose its own strategy.

Free Enterprise's environment editor, which is limited to eight variables, appears at the beginning of the game. The variables that you can change include limits on loans, interest rate, general condition of the economy, transportation cost, weight

Production Report For INDEED

	# of Units	Cost/Unit	Total Cost
Remaining Inventory	107	\$ 14.45	\$ 1,546
Plant Capacity	500	\$ 11.18	\$ 5,590
Current Production	243	\$ 14.40	\$ 3,499
10% Less	219	\$ 15.07	\$ 3,300
10% More	268	\$ 13.80	\$ 3,698

('ESC' for menu, '+' for next report,
 '-' for previous report)

The business simulation program *Free Enterprise*, one of the earliest programs of its kind available for the PC, is showing its age. This production report is indicative of the quality of the program as a whole: informative, but lacking such fundamental niceties as borders and color.

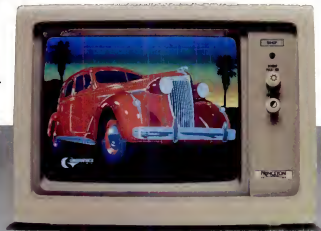
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■ BUSINESS SIMULATION

of research and development, price sensitivity, impact of advertising on market share, and random economic events. The random events, which can be industry- or company-specific, simulate such things as strikes and natural disasters.

THE SIGNS OF AGE As a training tool, *Free Enterprise* presents a number of unnecessary obstacles. Because the program is written in interpretive BASIC, it is intended for a 64K-byte machine. This means it excludes features found in other business simulations, features like graphics and relatively fast processing speed. True, there is a graph at the beginning of each turn that displays the previous quarter's sales, but it presents only a gross approximation of the actual situation. Second, while the manual is brief, well illustrated, and helpful, it is no substitute for on-line, context-sensitive help. And while the program is a well-thought-out simulation, the 40-column, black-and-white screen mode does nothing for its image. Finally, *Free Enterprise* is copy protected. (A program that requires BASIC.COM copy protected? Really, now.)

SRA's *Free Enterprise* may have been one of the first business simulators to reach the market, but it has definitely been left behind by the competition.

Vincent Puglia is a frequent contributor to PC Magazine.



FACT FILE



Free Enterprise
Science Research
Associates Inc.
155 N. Wacker Dr.
Chicago, IL 60606-1780
(312) 984-7000
List Price: \$100

Requires: 64K RAM,

one disk drive, DOS 1.1, BASIC; printer recommended.

In Short: SRA's *Free Enterprise* may have been one of the first business simulations available for the PC, but it's definitely showing its age, which is a shame, as the basic design of the simulation is very appealing.

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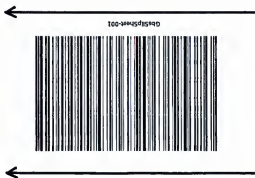
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PROLOG

Artificial intelligence is a term that conjures up visions of the HAL-9000 and robots that walk and talk, but the subject is actually more down-to-earth than that. Recently, AI research has begun moving into the mainstream computer environment. One of the AI programming tools, PROLOG, exists in a number of forms on the ever-popular personal computer.

PROLOG is not just for AI-related work. It provides a powerful method for relating data, which makes it a suitable environment for simple and complex database work. PROLOG is easy to learn and a good general-purpose programming language for many applications.

Prices for PROLOG systems range from \$95 to \$895. Some are interpreters

A Language for ARTIFICIAL INTELLIGENCE

PROLOG displays its value as a programming language in both the arcane sphere of artificial intelligence and the workaday world of database applications.

■ PROLOG

only, and others are compilers; some use a combination. Seven PROLOG systems are compared here. Those priced under \$100 are appropriate for learning tools and are sufficient for small development projects. The more-expensive products provide support for virtual memory and more-advanced features.

Each implementation reviewed here has some unique features. For example, Programming Logic Systems' micro-PROLOG uses a LISP-like syntax and a number of different user-interface front-ends. One, called SIMPLE, presents an English-like interface with rules like this:

```
X is_the_parent_of Y if X is_the_mother_of Y
or X is_the_father_of Y.
```

Automatic Design Associates' A.D.A. PROLOG comes in a number of different forms, from a public-domain version to a highly extended virtual memory version. Its major failing is the documentation. The lack of a compiler makes it inappropriate for distribution of applications.

Arity/PROLOG from Arity Corp. is the best all-around PROLOG implementation. Its documentation is one of the best, and it includes extensions such as B-tree support. The compiled code is faster than interpreted code and can be integrated with the interpreter.

Micro-PROLOG has the most versatile interface and is designed as a teaching tool. It succeeds admirably. It currently does not include a compiler, and its lack of virtual memory supports is limiting for production applications.

MPROLOG from Logicware is almost on par with Arity/PROLOG, but it lacks specific support for the PC. The documentation is complete but rather cumbersome. Its consolidator works like a compiler and achieves the same results in terms of speed and security.

PROLOG II from Expert Systems International is the only copy-protected implementation. It does have a compiler and a C-style "lint" checker. It supports the PC well and provides good production applications support.

Solution Systems' PROLOG-86 Plus is a well-implemented but limited system. It works as a teaching tool, but its lack of a compiler and virtual memory support is a problem for major applications.

PROLOG: HOW AND WHY

This AI logic programming language features pattern matching, backtracking, and a database.

Interest in artificial intelligence has also sparked an interest in AI languages. Major AI languages include LISP, Smalltalk, POP-2, and PROLOG. PROLOG is the language chosen for the Japanese 5th Generation development.

What qualifies PROLOG for this role? What makes PROLOG unique? How does PROLOG work, and what can it do for you? PROLOG is a logic programming language whose major features are pattern matching, backtracking, and a database. It can also serve as a general database.

In its simplest form, PROLOG can be viewed as a database of cards, each with a type and some associated fields such as

Business card:

```
Robert Rabbit, The Turtle Co.
Susan Samson, Itty Bitty Machines
Harry Hare, The Turtle Co.
John Johnson, XYZ Inc.
```

Business location:

```
XYZ Inc., New York
Itty Bitty Machines, Florida
The Turtle Co., California
```

This information can be translated into what is called a PROLOG clause as in

```
card("Robert Rabbit", "The Turtle Co.")
card("Susan Samson", "Itty Bitty Machines")
card("Harry Hare", "The Turtle Co.")
card("John Johnson", "XYZ Inc.")
```

```
location("XYZ Inc.", "New York")
location("Itty Bitty Machines", "Florida")
location("The Turtle Co.", "California")
```

The first item, card or location, is called a *functor*, and the items within the parentheses are called *arguments*. PROLOG can be used to search for a specific occurrence of an item in the database or multiple items. A specific item can be found using a pattern of the form: card("Robert Rabbit", "The Turtle Co."). Cards for people working for "The Turtle Company" can be found using a PROLOG variable that uses a pattern like: card(Person, "The Turtle Co.").

PROLOG will first find "Person" to be "Robert Rabbit" and leave a backtracking marker in the database. Backtracking is invoked when another alternative is needed. In this case, the next Person found will be "Harry Hare," and the backtracking marker will be moved to this position in the database. A third Person will not be found because none exists in the database after "Harry Hare."

PATTERN-MATCHING RULES The backtracking markers are not part of the database and many markers may be used when searching the database. The backtracking procedure and pattern matching are performed automatically by PROLOG. The pattern matching occurs using variables and constants and uses the following rules:

- A constant matches the same constant.
- A variable matches any constant, in which case the variable looks like a constant.
- A variable matches a variable, in which case they look like the same variable.

Backtracking undoes any variable pattern matching that occurs during a search. Person matches two constants but only one at a time. Patterns and backtracking can be more complex because the arguments can be a PROLOG clause, as well as a variable or constant. This allows search patterns such as

```
person (name (First_name, Last_name)
        , address (Street, City, State, ZIP_code)
        , Occupation
        )
```

Although a database of facts and a search facility like this are very useful, PROLOG is actually much more powerful. It's a complete programming language that uses the same syntax for both programs and data. A PROLOG program resides in the PROLOG database and is a collection of rules called "Horn clauses."

The syntax for a Horn clause differs depending upon the PROLOG implementation. Two common forms are

```
is_true :- fact1, fact2 ; fact3.
is_true if fact1 and fact2 or fact3.
```

The first version uses the original PROLOG syntax, while the second replaces the special items with their English meanings. Some systems actually support a number of different views. Such a clause in the database means that `is_true` is implied by the database if `fact1` and `fact2` are found by searching the database or, if this fails, `fact3` is found. The search for additional facts is performed when trying to see if `is_true` is in the database. Rules do not necessarily mean the information is in the database but rather how the information can be obtained.

The logical connectives, (and or) provide a way to describe relationships between facts and also allow searches within the database to become quite complex. In fact, PROLOG implementations normally provide a large number of built-in clauses that perform operations from searching the database to displaying text. Rules and facts can be intermixed in the database.

LIST OF FACTS PROLOG uses the list of facts to determine if a rule provides a fact based upon other facts within the database. This search is recursive and the same rule may be used a number of times to find a solution. PROLOG scans the list of facts from left to right and searches the database for a match. Backtracking occurs when an item cannot be found. PROLOG then tries to find another occurrence of the previous fact before continuing on.

The view of PROLOG presented thus far is called the "declarative" view of programming. The alternate view is called the "imperative" view, which takes into account how PROLOG searches the database. The PROLOG database is ordered, and search and backtracking is performed in a depth-first manner, starting from the first item in the database and proceeding to the last. A search fails to find a result if it makes it to the end of the database.

PROLOG implementations normally group facts and rules by the functor and index the database when performing a search to speed up the search process. The order of items in the database is therefore critical to how items are found in a search. In fact, a function in a conventional language can be viewed as a collection of PROLOG items with the same functor. For example:

Turbo PROLOG from Borland International is fast but limiting. It is similar to other PROLOG implementations in terms of ideas, but its Pascal-like syntax and restrictions make it seem as if it has a dialect of its own. It is a compiler-only system that can generate small- to medium-size applications but is not appropriate for large applications. It also lacks some of PROLOG's more general support. Its support of the PC is very good, though.

Overall, the quality of the products is good. Choosing the right system will involve considerations such as the size of the database, whether graphics or sound is necessary, and whether you need stand-alone, compiled applications as the final result.

PROLOG-86 Plus

PROLOG-86 Plus is a fast, low-cost PROLOG interpreter. It offers window support, though it does not extend to the user interface. The system lacks a compiler and does not provide virtual memory support, which can be a drawback for large applications.

The documentation is decent, even though the index covers only the built-in functions. The package does not have an on-line tutorial. Installation is quick and does not require any sort of installation program.

PROLOG-86 Plus supports both modules and Definite Clause Grammar, although the latter is provided by a loadable module. Sequential and random file access is supported but only in text form. There is no interface to other languages, but most DOS functions are available directly, in-



FACT FILE



PROLOG-86 Plus
Solution Systems
335 Washington St
Norwell, MA 02061
(617) 659-1571
List Price \$95
Requires: 256K RAM,
one disk drive, DOS 2.0

or later.

CIRCLE 622 ON READER SERVICE CARD

PROLOG

("PROLOG: HOW AND WHY" continued)

```
parent (Parent, Person) if mother (Parent, Person).
parent (Parent, Person) if father (Parent, Person).
```

```
ancestor (Ancestor, Person) if parent (Ancestor, Person).
ancestor (Ancestor, Person) if parent (Parent, Person).
and ancestor (Ancestor, Parent).
```

The two functions are "parent" and "ancestor." The ordering for ancestor is important because the first clause specifies that the parent is to be found first, and then ancestors of parents. These functions allow all combinations in the database to be located. The PROLOG variables are used as a communications mechanism between searches. For example, the database would probably include a collection of facts about mothers and fathers. The search for ancestors would start with the two ancestor arguments as some combination of constants and variables like ancestor (X, john) where we are looking for an ancestor of john. The search for a parent is now a search for the mother or father of john. This excludes a number of combinations. The variable Person is used to connect this relationship between database searches.

Control over the search mechanism is provided by the PROLOG cut operation. This is normally indicated by an exclamation point as in:

```
rule :- fact1, fact2, !, fact3.
```

The cut allows backtracking to occur when searching for occurrences of fact1 but prevents backtracking if fact1 and fact2 are found. The rule will be true if there is at least one combination of fact1 and fact2 found along with one or more occurrences of fact3. There may be more occurrences of fact1 and fact2, but PROLOG will not search for them because of the cut operation. PROLOG will also not search for an additional rule because of the cut.

MPROLOG has two additional versions of the cut operation that prevent backtracking within an or alternative and one that forces backtracking from a previous marker in the search. Arity/PROLOG has an additional control structure called a snip, which is designated by a pair of curly brackets as in {fact1, fact2}. Backtracking within a snip causes the search to continue from the item prior to the snip.

The combination of variables, control structures, backtracking, and pattern matching provides PROLOG with its power. PROLOG has more advantages and features, but this overview should give a glimpse of what can be done with PROLOG and why it is so different from other programming languages.—William G. Wong

cluding time and date information. Infix operators are supported with user-specified precedence up to 1,200.

Debugging programs in PROLOG-86 Plus can be difficult because of the limited support. A trace option is provided, but it does not give a breakpoint of single-step operations. Error handling is also limited.

PROLOG-86 Plus supports the use of an external text editor. It uses a number of commands to pass the name of a file to an editor. These include such options as loading a file when the editor returns and recalling the editor with the same file if a load error occurs. In order to use the editor of your choice, you must have sufficient memory for both programs.

The user interface presents the PROLOG question prompt (?-), and interaction with the text editor is the other primary interface. It's helpful to keep the editor on a RAMdisk, preferably an EMS RAM, as other versions use even more memory.

PROLOG-86 Plus is the fastest interpreter of all those reviewed here, though it falls short when compared with the compilers. Its lack of virtual memory support is one reason for its speed. PROLOG-86 Plus is an appropriate tool for learning

```
((is_ancestor X Y) (is_father Z Y) (is_ancestor X Z))
is_ancestor(X, Y) :- is_father(Z, Y), is_ancestor(X, Z).
is_ancestor Y if Z is_father Y and X is_ancestor Z.
```

Figure 1: An example of some of the formats available from micro-PROLOG.



FACT FILE



micro-PROLOG
Programming Logic
Systems Inc.
31 Crescent Dr.
Millford, CT 06460
(203) 877-7988
List Price: \$245
Requires: 256K RAM,

one disk drive, DOS 2.0 or later.

CIRCLE 634 ON READER SERVICE CARD

about PROLOG and building small applications.

micro-PROLOG

The oldest commercial PROLOG, micro-PROLOG for microcomputers has its roots in CP/M and has grown through MS-DOS to super minicomputers. The low-end MS-DOS version is \$99, while the Professional is \$245. The latter adds windowing, full DOS support, and use of all available memory. The Professional is also faster and has packaged run-time version for standalone applications. Both products optionally support APES (Augmented PROLOG for Expert Systems).

The documentation includes the user guide along with the book *Micro-PROLOG: Programming in Logic* (Prentice-Hall, 1984). The latter is an excellent introduction to PROLOG using the micro-PROLOG syntax similar to LISP, another AI programming language. The user guide is well organized with an index and appendices that cover the more esoteric details like the assembly language interface. Installation is easy, and the system is not copy protected.

The base micro-PROLOG syntax is LISP-like, which is unique to micro-PROLOG. This difference is not a problem for those unaccustomed to micro-PROLOG because the system comes with three additional user interfaces, including a syntax that matches the more conventional PROLOG syntax. Figure 1 is an example of



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*Jim Seymour, PC Week
May 13, 1986

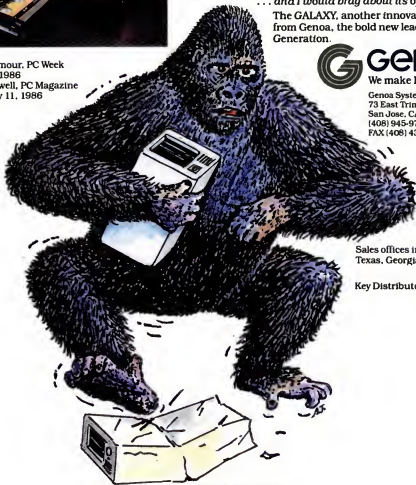
**Phil Wiswell, PC Magazine
February 11, 1986

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■ PROLOG

some of the formats available from micro-PROLOG: Micro-PROLOG uses a different internal form for numbers. Integers are up to eight decimal digits, while floating-point numbers have the same number of significant digits along with an 8-bit exponent. Time and date support is provided along with Definite Clause Grammar. Window support is available only in the Professional version. String manipulation is slow and costly because symbols must be converted to a list of characters, and lists use more memory.

Micro-PROLOG now uses all available memory but does not support a virtual memory scheme. Modules are supported, including import and export facilities. Tail recursion optimization is supported along with success popping. No compiler is available for the DOS version, but assembly language modules can be included by relinking the entire system. File access is random or sequential, and micro-PROLOG-specific binary files are supported. The latter provide a faster way to read or write database information but do not give access to binary files written by conventional languages.

A MENUED USER INTERFACE The user interface incorporates pull-down menus and a resident screen-oriented editor, which can be invoked under program control. The window and menu functions are also directly available. The source is provided for much of micro-PROLOG, including the various user interface models.

The APES product requires a copy of micro-PROLOG to operate. It provides a window-based system for building expert systems by augmenting micro-PROLOG. APES can produce prompts and explanations based upon information in the database for user interaction, but explicit descriptions may have to be added in some instances to augment the machine-generated English text.

Micro-PROLOG is a good interactive learning environment. The user interface is a definite plus, and a programmer has full access to these functions. Its limited string and numeric capabilities and the lack of virtual memory support make micro-PROLOG appropriate for small development projects only. For examples of how to extend the PROLOG user inter-

face, it is ideal.

Turbo PROLOG

Turbo PROLOG, the latest microcomputer PROLOG implementation, is the Pascal of PROLOGs. As a compiler, what it does, it does well, and what it doesn't do is really no problem. While Turbo PROLOG is the only microcomputer-based PROLOG system that does not come with an interpreter, the compiler is so fast that this limitation is inconsequential.

The Turbo PROLOG documentation consists of a single book, which serves as both a tutorial and a reference guide. The information is well presented, and although the package offers no on-line tutorial, the examples in the documentation are also supplied on disk. Note, however, that the documentation is not suitable for learning about PROLOG in general because of the differences between Turbo PROLOG and other versions.

Installation of Turbo PROLOG is just a matter of copying files to the work area and running the INSTALL program. Options and menu colors can be changed from within Turbo PROLOG.

Turbo PROLOG is a fast implementation and generates good compiled code as a result of some of the trade-offs made in its design. The first major difference between Turbo PROLOG and its competition is the required use of Pascal-like type definitions for parameters. This has the advantage of catching various errors at compile time and also allows the compiler to generate more efficient code. The drawback is that describing generalized procedures can be extremely tedious. For exam-

ple, computing the length of a list requires either a definition for a list of each type or generalizing a list so the elements can be of any structure. Other PROLOG implementations do not have this restriction. In general, Turbo PROLOG works well for specific definitions but can be difficult to use when defining generalized operations.

The second difference is the separation of the PROLOG database into database and clause sections. The database section may contain no more than a clause with a head, such as

```
isa(polly,bird)
```

while the clause section may have an option body, such as

```
isa(X,bird) :- has(X,feathers).
```

Items can be added and removed from the database but not from the clause section. Although many useful programs can be written within these restrictions, many more applications cannot. Most PROLOG implementations use a consolidated database, which allows any type of PROLOG clause to be added or deleted, with the possible exception of deleting a compiled clause.

The third difference is that Turbo PROLOG differentiates between primitive data types and clauses, while most PROLOG implementations do not. This can be a problem when existing applications are moved to Turbo PROLOG.

The fourth difference is Turbo PROLOG's requirement that all clauses with the same functor have the same number of arguments. Other PROLOGs allow clauses with the same functor, but with a different number of arguments, to coexist. Turbo PROLOG can handle this by explicitly naming each version, like name1 and name2, or using lists. This difference is also a concern when you're moving existing applications to Turbo PROLOG.

NO CALL OPERATION The other major difference is that Turbo PROLOG does not let variables appear in the list of clauses. This is known as the call operation in some PROLOGs. The call operation allows arbitrary search operations within the database to be chosen where the program runs.

Turbo PROLOG does support sequen-

**FACT FILE**



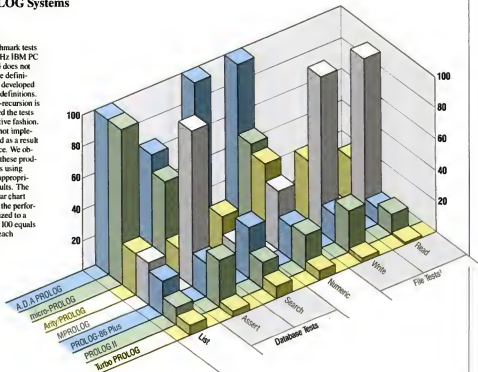
Turbo PROLOG
Borland International
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
List Price: \$99.95
Requires: 384K RAM,
two disk drives (hard disk
is recommended,
though). DOS 2.0 or later.
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PROLOG



Benchmark Tests: PROLOG Systems

The PROLOG benchmark tests were run on an 8-MHz IBM PC AT. Since PROLOG does not support true iterative definitions, the tests were developed using tail-recursive definitions. Optimization of tail-recursion is a feature that allowed the tests to be run in an iterative fashion. Some products did not implement this feature and as a result ran out of stack space. We obtained the times for these products by running tests using smaller values and appropriately scaling the results. The three-dimensional bar chart shows the results of the performance tests normalized to a scale of 100, where 100 equals the slowest time in each category.



Performance Times (given in seconds*)

	Database Tests ¹			File Tests		
	List	Assert	Search	Numeric	Write	Read
A.O.A. PROLOG	† 18	† 24	† 6	† 90	§	§
micro-PROLOG	17.97	20.11	0.82	49.54	† 10.5	† 15.65
Arity/PROLOG	4.90	6.59	1.63	44.38	43.95	57.49
MPROLOG	4.84	37.09	0.93	34.35	† 113	200
PROLOG-86 Plus	† 4	† 8	† 2	† 20	† 20	† 20
PROLOG II	2	11	1	21	30	25
Turbo PROLOG	1.00	1.31	0.50	5.00	3.06	2.91

The List benchmark test creates a list of 5,000 symbols, which is then appended to a null list, creating a copy.

The Database benchmark test consists of two functions. The Assert function adds 1,000 simple facts with two parameters to a memory-resident database. The parameters are either integers or symbols. The test then searches the database for the added facts, using failure and backtracking instead of recursion.

The Numeric benchmark test performs each of the four basic arithmetic functions 5,000 times. The arithmetic functions also control the number of repetitions.

The File benchmark test also consists of two functions. The first writes a single eight-character symbol 5,000 times, one symbol per line. This file is written to an empty 2-megabyte EMS-based RAMdisk. The file thus created is then read using the PROLOG Read function until the end of the file is reached.

*Some products gave times accurate to the nearest second, while others were accurate to .01 second. When applicable, times are given in decimal seconds. †Rules were not added in the Database Tests because Turbo PROLOG does not support such an option. Corresponding times from the other products for the addition of rules were the same as those for simple facts. ‡Indicates time obtained by performing the test using fewer iterations and multiplying by the appropriate factor. §Test would not run.

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PC Magazine

PC Magazine doesn't mince words. When they discover a great new product they let their readers know about it. Reviewers everywhere are writing about SmartNotes:

"A remarkable and enormously useful program. We've added it to our short list of indispensable utilities. ★★★★★ rating."

Review Board
InfoWorld

"SmartNotes is one of those utilities that, like The Norton Utilities, ProKey, or Sidekick, finds its way onto seriously used personal computers."

Richard Aaron
PC Magazine

"One of the smartest new PC products I've seen this year."

Stewart Alsop
PC Letter

"A stroke of marketing genius."

Esther Dyson
Release 1.0

"Brilliant. SmartNotes may well be the next Sidekick."

Bill Machrone
PC Magazine

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WORDPROCESSOR Stick notes almost anywhere. Program listings, DOS file directories, even other resident programs like Sidekick.

■ PROLOG

tial and random file access, as well as DOS subdirectory support. The interface with modules developed with other assembly languages or compilers is well documented. A virtual memory system is not included and cannot be implemented for the clause section, but a sample program is supplied for the database section.

Direct support for PC peripherals is built in to Turbo PROLOG, including sound and graphics routines. Window support is also directly accessible. Turbo PROLOG does not allow user-defined infix notation commonly found in other PROLOG implementations, and it does not have Definite Clause Grammar support built in, but this can be added, provided some syntax changes are made.

The Turbo PROLOG user interface is one of the best. Function keys and pull-down menus offer access to all aspects of the system. The screen presentation uses windows for the editor, tracing, results, and program output.

Debugging is quick and simple, since the editor is entered and the cursor is placed where the error is actually detected. The quickness of the compiler makes the system almost as fast as an interpreter, though creation of a database can be time consuming, depending upon its size.

Turbo PROLOG can save a program in source form or as a standalone application. Developing applications within a single file is very easy, and using multiple files is not difficult. Using modules created with different languages is more complex, but such applications usually warrant the additional work.

Turbo PROLOG's speed of compilation and the resulting code are impressive. It is faster than any PROLOG interpreter and comparable to the Arity/PROLOG compiled code. It wins out as the number of options is reduced, though it is more limited than Arity/PROLOG.

Turbo PROLOG provides an excellent environment for trying out some of PROLOG's interesting features such as pattern matching and backtracking. The ability to create standalone programs is also a plus for the program. However, Turbo PROLOG becomes very difficult to use when trying to use some of PROLOG's more-sophisticated features or when a large database is involved.

■ A.D.A. PROLOG is an interpreter only and can create standalone applications.

A.D.A. PROLOG

A.D.A. PROLOG is similar to Turbo PROLOG in that it has taken its own course of evolution. However, A.D.A. PROLOG extends PROLOG instead of changing its nature. Some of the extensions are invisible, while others are very evident. There are some additions, such as arrays, which are new to PROLOG but readily available in other programming languages. The way these extensions are implemented may please some and displease others. A.D.A. PROLOG comes in a number of flavors, from a public-domain version, which can be given away, to a virtual memory version with all available functions. The former is included with each of the subsequent versions. This is one way simple programs can be distributed at no cost.

The documentation is barely adequate, at best, and lacks an index, which is a significant omission because built-in operations are grouped by function instead of in

alphabetical order. A.D.A. PROLOG should invest in a spelling checker and a good word processor. There is a significant addendum with its own table of contents. It is also a third of the documentation. Printed installation and operating instructions are missing, but the system is not copy protected so copying all files on the disk is sufficient for installing it.

A.D.A. PROLOG has the normal data types, including 32-bit integers and double-precision IEEE floating-point numbers. Eight- and 16-bit characters and single-precision floating-point numbers are available in a stored format within a new PROLOG data type called "arrays." Multidimensional arrays are like arrays that are conventional in languages. Arrays are part of another item unique to A.D.A. PROLOG called "global variables." Arrays and global variables are manipulated by using LISP-like constructs. These additions operate with a different flavor from conventional PROLOG but should prove very useful for many applications.

Modules are implemented as a flexible hierarchical domain structure with import and export operations. A.D.A. PROLOG also adds the concept of "theories," which are groups of clauses within the database that can be manipulated as a whole, including the deletion of a theory.

A.D.A. PROLOG is an interpreter only and can create standalone applications. It does support a form of virtual memory that must be explicitly invoked, and this information is read-only. The changes are relatively minor, such as changing *consult* to *consult*.

A.D.A. PROLOG does not support tail recursion optimization but does support success popping, although this is normally disabled. This feature does provide a possible reduction in the amount of stack space.

File access includes random file support. Access to the DOS exec is provided, and this is also the mechanism used to invoke your favorite text editor. None is built into A.D.A. PROLOG. DOS interrupt support is provided along with direct *Intensity* access. Windowing for character data is included, but there is no support for graphics or sound. Conventional PROLOG trace and debugging features are available.



FACT FILE

A.D.A. PROLOG

Automata Design Associates

1570 Arroyo Way

Dresher, PA 19025

(215) 646-4894

List Price: VML PROLOG, \$200; VMA

PROLOG, \$250; VMI PROLOG, \$99.95;

FS PROLOG, \$49.95; ED PROLOG,

\$29.95; PD PROLOG, \$9.95 or free with the

purchase of any other A.D.A. PROLOG

package

Requires: PD and ED PROLOG require

256K RAM, and all higher levels require

320K RAM; one disk drive; and DOS 2.0 or

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■ PROLOG

The speed of execution depends upon whether the virtual memory system is used and if the required information is memory resident. The system is relatively quick for an interpreter but falls short of the PROLOG compilers available. A.D.A. PROLOG does have a few quirks, but these do not detract from its overall functionality.

A.D.A. PROLOG lacks only good documentation; otherwise it's a good package. The extensions may prove useful for some developers, but moving applications to other computers could be difficult.

MPROLOG

MPROLOG is part of a family of PROLOG implementations that spans many different machines from micros to mainframes, which makes it a good choice for development of applications to be used on other computers. This characteristic makes MPROLOG both very complete and somewhat deficient in specific support of PC hardware.

MPROLOG's documentation is extremely thorough, though a bit overwhelming. It comes in a very large binder but would have been much easier to read as two or three smaller, separate books instead. A different manual accompanies the separately available tutorial package, which is worth the additional cost for those just learning PROLOG. The tutorial is menu driven but somewhat slow, especially on a floppy-disk-based system. The menu systems present information within windows, but there does not seem to be any specific support within the language.

Installation is a relatively tedious pro-

cess and should be automated. Creating a standalone application is even more time consuming, though fortunately the documentation is very clear.

MPROLOG uses an enhanced form of PROLOG with true module support, including import and export of names and operations. This makes it one of the best PROLOG implementations for development projects involving a number of programmers.

MPROLOG excels in database support but does not include Arity/PROLOG's B-trees or hash tables. It does include floating-point calculations and file support, but window and sound support are not included. These options could be added by using the assembly language or Pascal interface.

The database is memory resident with no inherent virtual memory support. Tail recursion optimization is performed, but this can be turned off as necessary. This feature is useful when determining the path used to find a solution. An alternative specific cut provides a facility similar to the Arity/PROLOG "snip" (see Arity/PROLOG review for definition).

MPROLOG supports both infix notation with user-defined priorities and Definite Clause Grammars.

SUPERIOR DEBUGGING MPROLOG's debugging facilities are powerful, though there are a large number of options to remember. MPROLOG can also invoke the interactive mode while within the debugger, providing full access to MPROLOG's features while debugging.

MPROLOG provides access to a limited line editor, which can be used to modify the resident database. It is invoked when syntax errors are detected. DOS-style function key edit operations are available on a per-line basis.

In general, the user interface is limited. It does offer on-line help, but it's incomplete with respect to the language itself. MPROLOG keeps track of changes and modules and will not let you exit if changes have been made without saving the appropriate modules.

Although MPROLOG includes a compiler with some of its mainframe versions, none is provided with the PC version. It does, however, allow you to implement a process called "consolidation" to gener-

■ MPROLOG supports infix notation with user-defined priorities.

ate standalone applications or to enhance existing versions of the interpreter. The process requires two steps: preconsolidation and consolidation. The former is a limited form of compilation and can be performed on a per-module basis. A consolidated program still requires the MPROLOG interpreter to run, which is similar to the run-time support program of some BASIC implementations.

MPROLOG is comparable in speed to the Arity/PROLOG interpreter, which makes it slower than the Arity/PROLOG compiler and Turbo PROLOG.

Overall, MPROLOG is a good implementation of PROLOG. The on-line tutorial is appropriate for learning the language. Module and database support are excellent for large applications, though lack of virtual memory support can be limiting in such cases. Consolidation for standalone applications is great, but the extra cost and complexity when distributing the MPROLOG run-time system may be undesirable.

Arity/PROLOG

Arity/PROLOG is the heavyweight PROLOG implementation that comes in many forms, ranging from a low-cost (\$95) inter-

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MPROLOG
Logicware Inc.
5000 Birch St.
W. Tower, #3000
Newport Beach, CA
92660
(416) 665-0022
(416) 671-0644 (international inquiries)

List Price: \$495
Requires: 512K RAM, two disk drives (hard disk is recommended), DOS 2.1 or later.
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PC MAGAZINE FACT FILE



Arity/PROLOG
Arity Corp.
358 Baker Ave.
Concord, MA 01742
(617) 371-1243
List Price: Compiler and interpreter, \$795; interpreter alone, \$350

Requires: 512K RAM, one disk drive (hard disk drive recommended), DOS 2.0 or later.
CIRCLE 600 ON READER SERVICE CARD

■ PROLOG



PROLOG Systems: Summary of Features

	PROLOG-86 Plus Solution Systems (\$95.00)	Turbo PROLOG Borland International (\$99.95)	A.O.A. PROLOG Automata Design Associates (\$200.00)	micro-PROLOG Programming Logic Systems (\$245.00)	MPROLOG Logicware (\$495.00)	Arity/PROLOG Arity Corp. (\$795.00)	PROLOG II Expert Systems International (\$895.00)
Development Support							
Compiler	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Interpreter	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Tail recursion optimization	<input type="radio"/>	<input checked="" type="radio"/>	Success popping	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Language interface	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Definite clause grammar	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Debugging	Trace and spyoints	Trace	Trace and modifiable	Trace and spyoints	Trace and spyoints	Trace and spyoints	Trace and modifiable
Editor	User designated	Screen editor	Screen oriented	User defined	Line oriented	User defined	Screen oriented
Retain variable names	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Type checking	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data Types							
Integer precision	16 bits	16 bits	24 bits	8 digits	24 bits	16 bits	24 bits
Floating point	IEEE double- precision, 8087 support	IEEE double- precision	IEEE double- precision, 8087 support	8 digits	<input type="radio"/>	$\pm 1.0E \pm 99$	IEEE double- precision, 8087 support
Strings	127K bytes	64K bytes	64K bytes	60K bytes	64K bytes	16K bytes	64K bytes
Database references	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Data Operations							
String manipulation	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Time/date	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Trig/exponential	<input checked="" type="radio"/>	<input checked="" type="radio"/>	(needs 8087)	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	(needs 8087)
Bitwise logical	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Database Support							
Module support	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Virtual memory	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
PROLOG call (X)	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Clause to list	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Variable as functor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Add rules at run-time	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B-tree support	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Hashing support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
File Support							
Formatting	C syntax	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Random access	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Save current state	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
DOS directory support	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Device Support							
Windows	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Graphics	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Sound	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Low-Level Support							
Hardware ports	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Hardware interrupts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Software interrupts	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DOS interrupts	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Memory pointers	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

●—Yes ○—No

■ PROLOG

preter-only version to a professional, more expensive, interpreter/compiler system. Also available are a number of optional support modules, including an SQL database front end, an expert system development tool, a file interchange support, and a screen design program.

The documentation is well written and includes an introductory text, a language reference manual, and a system reference manual. The introduction, which caters to novice users, acts as a tutorial, since no on-line version is provided. A reference card would be a nice addition.

Installation on a hard disk system with

■ Although
Arity/PROLOG is
very powerful, its user
interface is somewhat
hostile for a novice.

space for all programs is easy. A floppy disk-based system is a bit more difficult to install, but it needs to be done only once.

ENHANCEMENTS Arity/PROLOG supports a PROLOG implementation that is a superset of the one described in *Programming in PROLOG*, by Clocksin and Mellish (Springer-Verlag, 1984). Enhancements include IEEE floating-point support, string manipulation operations, database references, resident B-tree support, hashing support, and direct access to PC functions like time, date, and screen support suitable for building a window interface. Definite Clause Grammar (DCG) support allows natural-language parsers to be built with relative ease.

Arity/PROLOG uses a transparent paging scheme that provides a true virtual memory system for a PROLOG database, which can exceed the PC 640K-byte memory limit. A large EMS-based RAMdisk is the best swapping device, though a hard disk may also be suitable. Arity/PROLOG also performs tail recursion optimization, which allows recursion to work as a more

DEFINITE CLAUSE GRAMMARS AND OTHER STRANGE THINGS

PROLOG's power comes from its symbolic and logic manipulation of data.

PROLOG can do a number of amazing things that are difficult or impossible to do with other languages. It is particularly strong in symbolic and logic manipulation of data. Definite Clause Grammar (DCG) support is one way to exploit these strengths. DCG is a way to describe "context-free grammars," which is a way to describe a language that is not context sensitive. An English sentence can be defined by such a grammar, even though its meaning must often be derived from information obtained from previous comments, as well as past experiences. Even so, DCG can be extremely useful in supporting natural-language interfaces, compilers, and other powerful tools.

DCG uses a syntax similar to PROLOG's rules. In fact, DCG rules are normally converted into PROLOG rules for faster evaluation. The conversion process is actually very simple. A sample set of DCG rules is

```
sentence --> noun_phrase, verb.
```

```
noun_phrase --> noun.
```

```
verb --> [smiles].
```

```
noun --> [george].
```

```
noun --> [jessica].
```

```
noun --> [mike].
```

The set of rules can be extended, but this is sufficient to describe two sentences: [george, smiles] and [jessica, smiles]. The square brackets are PROLOG's syntax for a list, which may contain an arbitrary number of items. The DCG uses the `-->` like the normal PROLOG "if" or ":-" in a rule. Backtracking works in the same fashion, but the parameters and pattern-matching semantics differ slightly. The sentence rule expands to reveal two parameters. These are lists that contain a string from the grammar. The first parameter is string to be parsed, and the second parameter is the tail end of the string that was not parsed. Lists with DCG rules are meant to match the leading items in the first parameter. PROLOG variables as well as constants, can be used with these lists. Real PROLOG clauses can be included by enclosing them within curly brackets. This could be used to search the PROLOG database, as in the following rule, to let a noun be any person in the database

```
noun --> [ X ], { person( X ) }.
```

The following are some examples using the sentence rule

```
sentence ([george, smiles], []).
```

```
sentence ([mike, jumps], []).
```

```
sentence ([X, smiles], []).
```

```
sentence (Sentence, []).
```

```
sentence ([jessica, smiles, at, Someone], [at, grover]).
```

The first clause will be true because the first argument represents a valid sentence based upon the DCG just defined. The second parameter is the empty list because there is nothing left after parsing the sentence. The second clause fails because "jumps" is not defined as a verb. The third finds sentences where X can be george, jessica, and mike. Likewise, the third finds a valid "sentence" (see example), which would first be [george, smiles].

PROLOG REVERSIBILITY The last example shows another general PROLOG feature called reversibility. The first part of the first argument is a valid part of the grammar and will be parsed. The last two items in this string would be leftover and must match the second argument. The pattern matching sets "Someone" to "grover". This marks the end of the DCG description.

The reversibility of PROLOG is unique to the language. It may not work with all items in the database, and many built-in PROLOG operations are not reversible. Even so, this feature can be very useful, as demonstrated by the prior example. This feature can be used for plan generation by having a set of rules that describe what valid plans look like and start with either the plan or the goal and obtain the other. This approach can even be used to see if a plan reaches a desired goal.

The next aspect of PROLOG to be covered is PROLOG's ability to use arguments that are part constant and part variable. This can be used to partially describe a situation or to get a result based upon a partial set of information. An argument that contains both constants and variables would be

```
find_manager (person (Name), manager_of (george, Name))
```

Note that the arguments are conventional PROLOG clauses. There is no restriction on the way constants and variables may be mixed, including items within the database. The best way to find out more about PROLOG's possibilities is to try it.

The last aspect of PROLOG to be presented is user-defined infix notation available with most PROLOG packages. The "and" and "or" operators in PROLOG use infix notation. The user-defined rules presented thus far use something called prefix notation, with the functor being the operator. User-defined infix notation allows any user-defined functor to be specified—one which is to be used as infix notation and what precedence is to be associated with it. This can lead to rules that look like

```
X ancestor_of Y if X parent_of Y.  
X ancestor_of Y if Z parent_of Y and X ancestor_of Z.
```

This is getting close to English, and the above example can be described using DCG.

Now for a few things that you will not find in PROLOG. The major missing data type is an array. Arrays can be simulated using lists and structures, but this is less efficient in terms of both speed and space. Other missing features are support for binary files and fixed-size data record support, as in C and Pascal. The latter is important when trying to use data files created by other applications. Formatted input and output also tends to be limited.

Even with some missing items, PROLOG has many features that make it stand out from the crowd of programming languages. The best way to see what can be done is to try out the features using one of the PROLOG implementations. This can be done quickly because most PROLOG products are interpreters or very fast compilers.

—William G. Wong

general form of iteration. Arity/PROLOG also allows a database to be partitioned into separate spaces called "worlds," which allow selective and more efficient access to information. Unfortunately, linkages between worlds can be cumbersome.

ENHANCED CUT OPERATION Built-in control constructs include CASE, IFTHEN, and IFTHENELSE. The PROLOG cut operation has been enhanced to include a new operation called a "snip," which prevents backtracking through an area defined by the snip. This approach is more powerful and more general than the cut operation. Random file access is supported but file access to binary files is limited. Debugging facilities are also very good.

The interface to compiled and assembled modules from languages other than PROLOG is clean and well documented, though somewhat complex. PROLOG programs developed in the interpreter can be compiled for faster execution, and compiled modules can be included in the interpreter by relinking the interpreter with the new modules. Dynamic linking is not supported for either compiled PROLOG or non-PROLOG modules.

Although Arity/PROLOG is very powerful, its user interface is somewhat hostile for a novice. The infamous DOS A> prompt is replaced with the equally infamous PROLOG ?- query prompt. Having the full PROLOG language at your disposal is better than the DOS batch facility, so extending the interface is relatively easy. Your favorite text editor can be used but only on files. Changes must be loaded into the database after exiting the editor.

Arity/PROLOG supports an enhanced version of PROLOG for developing sophisticated applications, both conventional and AI related. It is an adequate system on which to learn PROLOG, provided you can do without on-line help and a menu interface. Although Arity/PROLOG could use a better user interface, it is the best choice for serious users because of its sophistication and compiler support.

PROLOG II

PROLOG II is a friendly system. Its set of built-in operations is complete, and it

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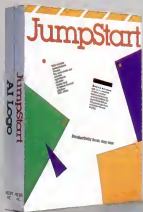
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■ PROLOG



FACT FILE

PROLOG II

Expert Systems International

1700 Walnut St.

Philadelphia, PA 19103

(215) 735-8510

List Price: \$895 (includes interpreter and compiler)

Requires: 384K RAM, two disk drives, DOS 2.0 or later.

CIRCLE 433 ON READER SERVICE CARD

makes good use of the PC, especially with its window support. Unfortunately, however, it is copy protected.

The documentation comes in one large binder. And although it's well organized, it could be broken up into more-manageable pieces. Also included is a demo disk and on-line help but no interactive tutorial.

The installation procedure uses a key disk and is menu driven. It is a relatively painless process, if everything is set up properly. Unfortunately, one deinstallation messed up my disk directory for some unknown reason. Luckily everything was recovered, including the proper installation count, as there are only two on the disk.

ENHANCEMENTS PROLOG II offers a number of enhancements over conventional implementations, including modules with an import and export facility. It supports floating-point numbers, windows, and an assembly language interface. Definite Clause Grammar support is provided through a separate module. Infix notation is supported, but priority numbers are limited to 256.

Also available in PROLOG II is true virtual memory support along with other enhancements, including the use of tail recursion optimization. A compiler is included so modules that have been developed with the interpreter can be compiled. Compiled and interpreted code can be mixed, and while compiled code has the advantage of speed, it cannot be displayed like interpreted code.

The debugging facility uses pop-up windows and menus. It is very flexible and easy to use, and although it does not allow

■ PROLOG II is a friendly system.

Unfortunately, however, it is copy protected.

access to PROLOG operations, it can be modified. The documentation describes those options that are available when writing a new debugger. This feature is particularly useful when trying to debug very complex systems.

PROLOG II contains a window-based screen editor, which can be customized and invoked from within an application. The editor is relatively sophisticated and can be easily extended. Function keys can be redefined, too.

The user interface presents the conventional PROLOG question prompt (?-), but various options, including help, can be displayed using function keys. The help option can be used explicitly from within an application.

PROLOG II is slower than the other interpreters for some operations. The compiler provides better results, though they are not as good as those from Turbo PROLOG and Arity/PROLOG.

Overall, PROLOG II is a good development and production system. It is appropriate for learning PROLOG, in spite of the lack of an on-line tutorial. Its major drawback is that it's copy protected.



EDITOR'S CHOICE

Although most of the compiler-based PROLOG implementations were considered good candidates for Editor's Choice, each fell short in certain important areas. None provide adequate support for binary data files or Pascal-style record I/O. Support for PC-specific features is usually limited, and spartan user interfaces are the norm.

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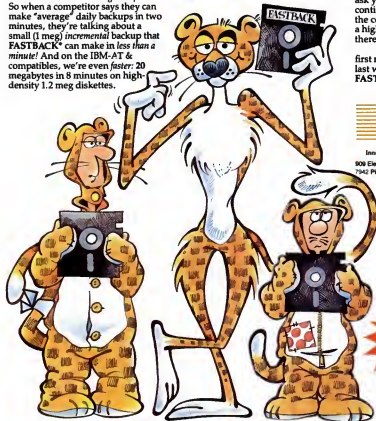
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MUSICAL INTERLUDES

Your PC can give you the piano lessons you never had or let you display more-advanced musical talents. A series of programs from Roland and a music synthesizer board from Tecmar form the cores of two unique music systems.

with the PC

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ou and your PC can make beautiful music together, even if you have never before played a note or your budget is a shoestring too short to tie together a complete computerized music system. Current add-on and add-in opportunities can turn any ordinary PC into a musical teaching tool that will help you hone your melodic skills or into an inexpensive music synthesizer whose capabilities rival those of many dedicated music-making machines.

If you have no musical experience, the Musicom computerized

■ MUSICAL INTERLUDES

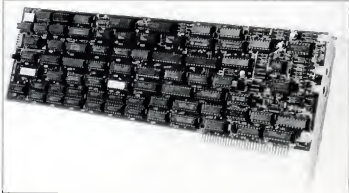


To run the Musicom software, you need a synthesizer or keyboard with a MIDI interface. We used Roland's alpha Juno-2, one of the least expensive and most powerful velocity-sensitive keyboards available. Also required to run the software are (from left to right) a Sony microphone, Roland's MPU-401 MIDI Processing Unit, and the Xanadu IFM-PC card.

music courses may help you take your first steps toward a Carnegie Hall debut. A combination effort built from a Roland-Corp music synthesizer, some specialized hardware, and programs written by Xanadu International, Musicom is a complete system designed to teach you everything from keyboard rudiments to advanced aspects of composition and theory using a PC and a music synthesizer.

Musicom's goal is to let you use the synthesizer as a vehicle for your musical education. The PC and Musicom are tools to help you learn the musical alphabet and improve your vocal or instrumental performing skills.

If, on the other hand, you are the typical performing artist—long on talent and short on cash—and you happen to have a PC, you'll want to investigate the Tecmar Music Synthesis System (TMSS). This relatively inexpensive (under \$800) expansion board turns any model PC (except the PCjr) into a high-powered music synthesizer with built-in sequencer/digital recorder.



The Tecmar Music Synthesis System board can create up to 16 independent voices. When you install it, your PC becomes a completely programmable music synthesizer.

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electronic piano-style keyboard and play with genuine expression. TMSS also interfaces with other synthesizers, sequencers, and music-making and -manipulating hardware and can serve as the foundation of a complete music studio.

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The 2400I Internal Modem Card fits into any expansion slot, as it is a compact half-card modem. It's designed specifically to operate in the IBM Personal Computer PC/XT/AT family and compatible computers. The rear panel has two RJ-11C modular telephone jacks for the telephone line and the telephone set. The modem can be set for COM1 or COM2. The 2400I modem allows asynchronous communications with remote computers and other data terminal equipment over standard voice grade telephone lines. The 2400E External Modem offers the user asynchronous or synchronous communications. The 2400E is en-

closed in a slimline plastic enclosure. The front panel displays the eight modem status indicator lights. It works on any computer or terminal with an RS-232C serial port.

Elaborate

Not to be forgotten are our 300/1200 baud modems. The Internal Modem Card is designed for the PC, PC/XT and most compatibles; it occupies one full length slot and the internal speaker lets you know the call progress. An RS-232C serial port is standard, COM1 or COM2; you can use the port for other peripherals when the modem is not being used. Our External stand alone modem can be used with any computer or terminal which utilizes an RS-232C serial port. It also comes with 8 status indicator lamps and a snap off front panel that allows for quick setting of the switches for all types of communication packages. At \$139 and \$149, these are the best price/performance modems for most communications.

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CIRCLE 235 ON READER SERVICE CARD

■ MUSICAL INTERLUDES

THE INTERNATIONAL CONNECTION Musicom and the TMS system are not at all similar, but as different as these two products are, they share one important element: MIDI (musical instru-

ment digital interface). Musicom absolutely requires MIDI, and it is a very desirable option for the TMSS.

MIDI is a music industry international standard for connecting together digital

electronic equipment—primarily synthesizers. Under the MIDI standard, any electronic musical instruments and control systems can be connected.

In the Musicom system, the MIDI interface consists of two parts: a small metal box manufactured by Roland called the MPU-401 MIDI Processing Unit (probably the standard MIDI interface unit in the PC-compatible environment) and a special 5-inch-long expansion card, the IFM-PC, made by Xanadu. The two components are connected using a cable similar to the one for an RS-232 serial interface.

The MPU-401 adapts the signals from the Xanadu card into the MIDI standard.

■ The Xanadu IFM-PC, the key to Musicom's power, can listen to your singing and playing and judge the musical pitch and rhythm.

In addition to the cable that links it to the PC, three MIDI cables connect it (one in and two outs) as well as sync and metronome outputs and a tape input and output. The MPU-401 requires no separate power cable because it draws its electrical supply from its host computer through its signal interconnection cable.

The Xanadu IFM-PC, the key to Musicom's power, is far more than just a quasi-serial interface to link the MPU-401 to the PC. It includes specialized circuitry that endows the system with some near-miraculous abilities: it can listen to your singing and playing and judge the musical pitch and rhythm of the performance.

A miniature phone jack on the retaining bracket of the Xanadu card allows you to plug in a low-impedance microphone (Roland recommends a Sony ECM-220T condenser microphone). The circuitry on the card then amplifies, digitizes, and analyzes the signal from the microphone. The Musicom program uses the data from the

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Xanadu card to monitor your musical progress.

A WHOLE CURRICULUM Musicom, developed in Israel by Xanadu International, has been available in Europe for about 2 years. Roland has licensed and adapted the courses for the United States and currently offers five Musicom courses. *Rapid Piano* introduces such keyboard basics as distinguishing black and white keys and then progresses to teaching pitch and rhythm notation and developing performance

- The software uses a copy-limiting scheme that prevents you from using it on more than one computer.

technique. *Ear Training and Sight Singing* starts with single-note singing and progresses through singing tunes and intervals by imitation and singing from musical notation. *Keyboard Fundamentals* teaches musical notation, keyboard playing, rhythm, and key structure. *Intermediate Music Theory: Two Part Writing* discusses harmonic intervals, the occurrence and resolution of dissonance, parallel fifths and octaves, and dissonant chromatic notes. *Intermediate Music Theory: Triad Structure* investigates the nature of the chord, the origin of triads, and variation on triads (such as inversions), and relates triads to interval structure. Future titles will fill in the gaps in the current offerings and include courses in jazz and rock. According to a spokesperson at Roland, which is now helping design the courses, development of new titles is ongoing.

Each Musicom course comes in a vinyl binder that includes a manual and two or more floppy disks. The software uses a copy-limiting scheme that prevents you from using it on more than one computer. The first time you run the program, it memorizes the IFM-PC card in its host computer; that program or backup copies

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■ MUSICAL INTERLUDES

will thereafter work with only that one IFM-PC card. You can, however, make as many backup copies of the program as your state of mind requires.

The accompanying manuals do not du-

plicate the on-disk instructional materials but rather provide background material and ancillary information, such as all-too-short biographies of composers (in the case of *Rapid Piano*) or posture tips and musi-

cal examples (in *Ear Training*).

Reading a Musicom manual without trying the program might mislead you into taking the Musicom system too lightly. You can probably plow from cover to cover in an hour or two, which (at \$495 a course) makes rather expensive reading. Each course, however, can take up to a year to complete satisfactorily. As with learning any skill, following the Musicom system requires practice—in fact, it enforces practice. More than that, it monitors your progress. It's like having an instructor with you as you metamorphose from a stumbling-fingers to a virtuoso.

Although Musicom might effectively be used by itself in teaching musical performance, the instructions rightly point out that the various courses are best used as supplements to professional musical instruction. Only a human tutor can recognize the full implications of the strengths and weaknesses the student displays as he progresses in his training. Many colleges and music schools already use Musicom software to supplement their classes.

LOVE AT FIRST TOUCH In the Musicom system, the synthesizer plays the role of companion to the computer. The software communicates with the synthesizer to monitor your learning progress. Nearly any synthesizer—or even keyboard—with a MIDI interface will work with the Musicom software. Roland's alpha Juno-2 is one of the least-expensive velocity-sensitive keyboards available. Its velocity sensing allows it to send MIDI signals not only about which keys you strike but also about how hard you strike each key, helping you add expression to your music through your fingerwork. A less-expensive sibling, the alpha Juno-1, will also work with the Musicom system but is not velocity sensitive.

Despite its comparatively low price, the alpha Juno-2 is a very capable, powerful synthesizer that you are not likely to outgrow so long as you don't turn professional. Its limitations will not hold you back (as learning on a cheap horn or violin might), and it offers so much variety that only the most jaded technophile could become bored with it. It starts off with 64 predefined voices ranging from simple sine waves and simulations of acoustic instruments to sounds that might better be classi-

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fied as extraterrestrial effects.

Those sounds are the beginning and not the end. You can customize and manipulate any and all of them by pressing a couple of buttons (actually membrane switches) and spinning a wheel (called the alpha-dial). You can create and record another 64 voices in the electronic memory of the alpha Juno-2, whose definitions you can protect against erasure when power is turned off.

INTRODUCING THE FINGERS The most rudimentary of the Musicom courses is *Rapid Piano*, which makes no assumptions about your musical knowledge. Even if you've never seen the ivories of a piano

■ The format of the lessons is two-part, the rough equivalent of lecture and laboratory approaches. First the concepts are explained; then you practice them.

before, you should have no trouble starting out with *Rapid Piano*. In essence, the program is a familiarization tour that first introduces you to the keys and their arrangement and helps you overcome whatever fears you might have.

Once reassured, you're led into the territory of musical notation; *Rapid Piano* first teaches you the letter names of the notes of each octave and their correspondence to the sounds the keyboard makes, then moves on to the staff and position notation on it. The next bold step takes you to the correspondence between the staff and the keyboard. The lesson concludes with note lengths and rhythm.

The format of the lessons is two-part, the rough equivalent of lecture and laboratory approaches. First the concepts are explained; then you practice them. You are encouraged to practice with what's called a

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■ MUSICAL INTERLUDES

game, but the definition is a loose one. You match the screen prompts to key-strokes, and you're then rewarded with points (and a musical trill) when you are successful and punished by a less pleasant

sound and clipping of your points when you are wrong. It's about as straightforward and unexciting as you can get. You don't even get to zap aliens as you do with typing tutors.

If you are a perfect student, you'll think that Roland has shortchanged the power of the PC in education: the machine does little more than tally your answers and keep score. Graphics are limited but adequate: displays are mostly 40-column text with graphic embellishment to show the staff and musical notation. However, if you make consistent (not random) mistakes that indicate that you misunderstand an underlying concept, the program detects the pattern of your errors and provides specialized help. Like an iceberg, much of the power of the system is hidden beneath the surface.

The Musicom system comes into its own in its *Ear Training and Sight Singing* course. Although the on-screen games are hardly more laudable than those of *Rapid Piano*, it adds an almost wondrous feature:

■ You get instant feedback about whether you're singing sharp, flat, or right on. It's like having a singing coach with perfect pitch constantly correcting you.

a computer-connected microphone. The microphone, connected to the Xanadu expansion/interface card, allows the computer to monitor your singing progress. It can identify the actual pitch that you sing and graphically display it on your monitor screen. You get instant feedback about whether you're singing sharp, flat, or right on. It's like having a singing coach with perfect pitch constantly correcting you. It teaches you to read standard musical notation and sing what you read, concentrating on important intervals and enforcing practice on them all.

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■ MUSICAL INTERLUDES

synthesizer. Through simple keyboard commands, you can easily manipulate every aspect of the sound. The TMS System has so many features and changeable parameters, it may take professionals months to master them all. However, the system is so easy to work with that anyone with an ear sensitive enough to listen to a tune can use TMSS to explore the world of electronic music.

TMSS is a high-performance, multi-timbral stereo synthesizer condensed onto a single full-length, 8-bit-bus PC expansion board. Up to four boards can be installed into a single computer. A single

■ The Tecmar Music Synthesis System is a high-performance, multitimbral stereo synthesizer condensed onto a single full-length expansion board.

board can create up to 16 independent voices; four boards will make a single synthesizer system with 64 independent oscillators. Not only can one voice be made from a number of oscillators, but a single oscillator can be shared among a number of voices.

In addition to the hardware, the TMSS package includes a large program (180K bytes) to control it as well as almost any other device that can be connected to the host PC through a standard MIDI interface.

TMSS requires an external amplifier to turn the electrical signals it generates into sound. The board supplies two unbalanced high-level (about 1-volt) audio outputs through standard RCA (phono or pin) jacks and can be plugged directly into the auxiliary or tuner input of a stereo system. TMSS can also be used with monophonic musical instrument amplifiers that have line-level inputs.

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Lotus 1-2-3	✓					✓		✓					495 ⁰⁰
Symphony	✓					✓		✓		✓			695 ⁰⁰
Framework	✓		✓			✓		✓		✓			695 ⁰⁰
Enable	✓		✓			✓		✓		✓			695 ⁰⁰
Smart	✓		✓			✓		✓		✓		✓	895 ⁰⁰

**NETWORK VERSION
AVAILABLE**



■ MUSICAL INTERLUDES

Each voice block in the system actually consists of two digital waveform generators that give you control of their spectral, pitch, and amplitude envelopes, as well as overall amplitude and stereo panning control. The output of a single waveform generator can be programmed from a sequence of up to nine waveforms or sound samples. Although a library of standard definitions is built into the software, you can edit or modify each waveform or create new ones.

Built into TMSS and controlled by the software is a digital sequencer/recorder system that can store and play back up to 65,000 notes in a 640K-byte host system. MIDI control data—for instance, pitch

■ **Built into TMSS**
and controlled by the software is a digital sequencer/recorder system that can store and play back up to 65,000 notes.

wheel, breath changes, and other program changes—can also be recorded. The system allows up to 64 tracks to be copied, mixed, and/or filtered. Individual tracks can even be "punched in" during editing.

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■ MUSICAL INTERLUDES

overtone with a numeric value (0 through 99) that is then displayed on a bar chart. Simultaneously, TMSS creates an audible approximation of the resulting sound using the system's 16 internal independent oscil-

lators. Once you find the perfect combination of overtones, you press a function key to compute the exact waveform, which can then be stored and played polyphonically by the system. Up to 64 different wave-

forms can be loaded into the program at a time.

A voice is made from up to nine such waveforms combined in three envelopes. The shape of the envelopes is created using the same waveform editor.

The current implementation of TMSS cannot capture real-world sounds and manipulate them, though Tecmar says such a feature is on the drawing board. Currently, captured sounds are available on request from the factory (on disk), and you can easily load them into the TMSS program.

PLUGGING IN TMSS can make music without any additional hardware add-ons, using the IBM keyboard. However, you'll probably want to add a velocity-sensitive keyboard to take full advantage of TMSS's capabilities. To connect a keyboard, you'll also need a MIDI interface, which means giving up another PC slot. (The Xanadu-Roland MIDI interface and the alpha Juno-2 synthesizer are two products that handle these roles extremely well.) The sequencer/programmer in TMSS can also take advantage of the voices of the keyboard/synthesizer you use with the system.

The TMSS board uses 12-bit digital-to-analog conversion operating at a 50-KHz sampling rate. This design allows sound quality in the 80 decibel signal-to-noise range, approaching that of compact discs, which use 16-bit quantization. Actual installations may fall short of these ultimate capabilities: the PC chassis is full of strange electronic noises generated by the computer's logic circuitry, and these signals can get coupled into TMSS, resulting in a pervasive background noise. The noise level is sensitive to card placement: some slots are notably more quiet than others. Sound quality is superior to that of systems based on other computers, but the test unit exhibited an unusual amount of distortion in some of its waveforms.

TMSS makes heavy demands on the processing capacity of its host computer. In its current form, installed in a standard PC, TMSS may not be able to keep up with rapid keystrokes. Even in the 80286-based system I used for testing, editing procedures bogged down the sequencer and temporarily confused the system but not for more than a second or so. Even at its fastest tempo with complex harmony and

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■ MUSICAL INTERLUDES

several different instruments to each part, however, the sequencer played it back.

THE MUSICAL PC Musicom and TMSS illustrate the range of the PC's involvement in music making. In the Musicom system, the PC is only loosely linked to the production and control of sound: it is simply a command center and interface. An external synthesizer creates the sounds, controls loudness, timbre, and, for the most part, pitch. If the connection with the computer is broken, the synthesizer can perform on its own.

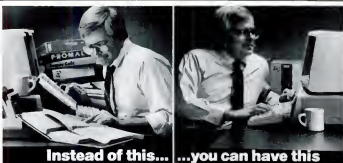
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Winn L. Rosch is a contributing editor of PC Magazine.



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■ PC LAB NOTES: DEBUG TIPS ■ CHARLES PETZOLD

EXPLORING WITH DEBUG

If you want to learn how to program better, fix a program bug, or write a patch to get rid of an annoyance in an application, trying out DEBUG is well worth your while.

I was the kind of kid who took toasters apart to see how they worked. When I outgrew toasters, I turned to computers. The interesting thing about taking apart computers is that you don't even need a screwdriver. All you need is DEBUG.

The DEBUG program included with PC-DOS is intended to be used for debugging programs, but it's really much more powerful than that. DEBUG is a window into the most-intimate internal workings of your machine. By using DEBUG, you can become more familiar with the architecture of the microprocessor in your PC, explore the organization of the PC's memory, and see how the various pieces of your system (applications, resident programs, DOS, drivers, the BIOS, and hardware) all fit together.

I've probably spent more time with DEBUG looking at other people's programs than at my own, and I'm going to show you some of the techniques I use to do this. It's a great way to learn assembly language programming, and it can help you fix programs that may contain bugs or other annoyances.

LOOKING AT MEMORY For the most part, exploring with DEBUG means looking at the memory in your PC. The contents of the PC's memory are binary numbers (represented in DEBUG by their hexadecimal equivalents) that can be divided into three categories: code, data, and junk.

By code, I mean machine language, the numbers that represent instructions that the

microprocessor can execute. DEBUG lets you translate machine code back into assembly language mnemonics by using the U (Unassemble) command. A pair of innocent-looking bytes like CD 21, for instance, equate to the assembly language mnemonic

INT 21

which is the DOS function-call interrupt. You can insert code into memory with DEBUG's A (Assemble) command.

Data is information used by a program. Data includes text strings, tables, stored numbers, and so on. Data is viewed in DEBUG with the D (Dump) command and

entered into memory with the E (Enter) or F (Fill) commands.

Junk is anything left over: memory contents that serve no purpose right at the moment and might just as well be random numbers. For example, when you're using a spreadsheet program, the program itself is code and the actual spreadsheet stored in memory is data. When you exit the spreadsheet program, all those numbers in memory do not disappear but instead simply become junk.

DATA VS. JUNK When looking at memory in DEBUG, there's no clear way to tell whether a particular block of memory is code, data, or junk, or where one leaves off and another begins. If you use the Dump command and see some instructions over at the right side of the display, it's probably data, but it could be junk. If the contents of the dump appear to be unordered and random, it's probably code, but it could be data, or junk again. If you use Unassemble and see some instructions prefaced with DB, or some "protected mode" 80286 instructions, or something that would make no sense if it were executed, you're probably not looking at code.

Making the distinction between code, data, and junk takes practice. It isn't easy, even for veterans.

DEBUG always refers to memory addresses in what is called *segment:offset* form. The segment and offset addresses are both four-digit hexadecimal numbers ranging from 0000h through FFFFh (the "h" suffix means hexadecimal). The absolute address (which can be represented

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■ PC LAB NOTES

as a five-digit hexadecimal number from 00000h through FFFFFh) is equal to the offset address plus 16 times the segment address. However, DEBUG never uses the absolute offset format.

The same absolute address can be written with many different combinations of segment and offset addresses. The correct combination is the one used by the program executing the code or using the data. You don't always need to use the segment address in DEBUG commands because DEBUG will use a default. Whenever you're using a command that references memory as data (Dump, Enter, or Fill), the default segment address is the value stored in register DS. Commands that reference memory as code (Go, Trace, Assemble, and Unassemble) use the default segment stored in register CS.

THE ART OF DISASSEMBLING Disassembling is a form of "reverse engineering" in which you use DEBUG to turn a program into readable assembly language mnemonics and data blocks.

Unfortunately, you can't translate machine code back into the original assembly language source code. In the original conversion from source program to the assembled (or compiled) machine code, much crucial information is lost. All of the programmer's documentation and comments are gone, for one thing, and all labels and variable names are converted to addresses, for another (so JUMP COLOR_SET turns into JMP D148).

Moreover, despite these omissions and shortenings, disassembled listings can be quite long. Each printed page of a disassembled program is equivalent to about 150 bytes of machine code; a 10K-byte program will disassemble into a 67-page listing. Obviously, then, while learning the techniques of using DEBUG, you'll want to stick with short programs. But with enough patience and dedication, you can get a fairly good understanding of the workings of almost any program by studying the disassembled code.

(Note that some software programs have license agreements containing provisions that prohibit the buyer from disassembling the code. Some people believe that these provisions exist to protect secrets embedded in the programs; others argue

that the software manufacturers just don't want users to see how poorly written their code is. As far as I know, there hasn't yet been a court case where DEBUG has been cited as a burglary tool for breaking and entering. [Nor do we expect there to be any.—Ed.]

A WORKING EXAMPLE Let's say that you've just purchased PC-DOS 3.1 and have discovered the LABEL.COM program, which lets you create or change a

■ Disassembling turns a program into readable assembly language mnemonics and data blocks.

volume label on disks. You're curious how the program accomplishes this. The program doesn't seem too long (1,826 bytes), and so it may be worth the effort to disassemble it.

The first step is to determine how the 1,826 bytes of LABEL.COM break down into code and data. Load LABEL.COM into DEBUG by entering

```
DEBUG LABEL.COM
```

and give an R (Register) command (type R and hit Return). Register CX gives the size of the program in hexadecimal. For LABEL 3.1, that size is 722h. So, since .COM programs always begin at offset 100h, the program begins at 100h and ends at 821h. (Adding 100h and 722h gives the next available address after the program, and so the program ends 1 byte before that address.) The Register command also displays the first instruction of the program, which is at offset 100h. In this case, that instruction is

```
JMP 0370
```

It looks like LABEL.COM is jumping over some initial data—a typical technique in .COM programs.

Now, do a dump of the entire program to get a visual feel for how it divides into code and data:

```
D 100 L 722
```

Our guess was right. Up to address 370h, most of what you'll see on the right side of the dump listing is text, in the form of messages and a copyright notice. Following that, the bytes in the dump display don't seem to have any pattern, which probably means that we're looking at code. But then around address 5C0h a string of hexadecimal digits shows up surrounded by a bunch of zeros. A few lines later, it goes back to looking like code.

So, you'll have to take a closer look around that strange piece of data in the middle. This requires the Unassemble command.

As you do this, take some notes about what ranges of addresses are code and which are data. After you're pretty sure this information is correct, use an ASCII text editor to prepare a small file called LABEL.SCR. This will be a DEBUG script file that turns the .COM program into a disassembled program. For LABEL 3.1 it looks like this:

```
U 100 102
D 103 34F
U 370 504
D 505 5F1
U 5F2 821
Q
```

Now, you can verify that you got it right by executing:

```
DEBUG LABEL.COM <LABEL.SCR
```

When you get something that looks good and correct (and sometimes there's a lot of trial and error involved), the next step is to print it out:

```
DEBUG LABEL.COM <LABEL.SCR >PRN
```

The listing will be about 8½ pages long.

Now the real work begins with annotating the listing. I usually first go through and circle all the addresses following CALL statements. These addresses are subroutines, and the division of a program into subroutines is the most important structural element. Using these addresses, I can block out each subroutine and start to figure out what each one does.

Another important key to understanding the program is to find the places where it communicates with the operating system, BIOS, or hardware outside of the program. To do this, mark all the INT instructions. The INT 21 instructions, for

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instance, are DOS function calls; the value of AH at the time of the call indicates what call it is. Using the DOS *Technical Reference* manual, you can then look them up to determine what the program is requesting of DOS at each INT 21.

LABEL.COM starts off by branching to address 370h, where it sets the stack pointer, clears the direction flag, calls seven subroutines, and then executes an INT 21 with AH equal to 4Ch. This DOS function call terminates the program.

This is a nice, clean beginning to the program. Those seven subroutines mean that the programmer initially broke down the job of LABEL.COM into seven distinct tasks.

The first two subroutine calls are

```
CALL 038F
CALL 03A5
```

The code from address 38F through 3A4 is the first subroutine. When you execute

```
U 38F 3A4
```

you'll see disassembled statements that look like this:

```
XXXX:038F 50      PUSH AX
XXXX:0390 B430    MOV  AH,30
XXXX:0392 CD21    INT  21
XXXX:0394 30B3FA  CMP  AX,0AB3
XXXX:0397 748A    JE   03A3
XXXX:0399 DAF0C1  MOV  DX,01EC
XXXX:039C B469    MOV  AH,9
XXXX:039E CD21    INT  21
XXXX:03A8 59C0E2  JMP  5AF
XXXX:03AA 53      POP  AX
XXXX:03A4 C3      RET
```

That first INT 21 call with AH set to 30h returns the DOS version number in register AX. The program compares AX to 0A03h, which compares the major version returned in AL to 3, and the minor version returned in AH to 10. If AX is equal to 0A03h (that is, if the DOS version is 3.1), then the program jumps to the end of the subroutine. If not, it loads DX with the value 01EC, calls INT 21 again with AH equal to 9, then jumps to address 5AF, somewhere outside the subroutine.

Why does the program load the value 1EC into DX? What is that number? Well, Function Call 9 prints a string that begins at the address in register DX. So, sure enough, if you look up at the top of the listing, you'll see that a string of text begins at that address and reads "Incorrect DOS version."

After printing this error message, the program jumps to location 5AFh, which terminates the program through DOS Function Call 4Ch. So, now you have a complete understanding of this first subroutine. It checks the DOS version. If it doesn't find DOS Version 3.10, the program prints an error message and exits. Obviously, that's a pretty simple type of subroutine and a standard check in many DOS programs, but the same general methods apply when disassembling the rest of the program.

SIGNPOSTS UP AHEAD The INT 21 instructions in LABEL.COM and other programs are important because they indicate where the program is communicating with the "outside world." DOS function calls are only one of several signposts you will see in disassembled programs.

Many programs will also contain BIOS function calls. These will also be INT instructions, but with numbers less than 20h. They are documented in the *Technical Reference* manuals for the PC, XT, and AT.

These manuals will also tell you the meanings of any IN and OUT instructions, which indicate that the program is communicating with hardware.

You should be on the lookout for places in the disassembled code where the value of DS or ES is set to 0h or 40h. These values mean the program is referencing locations in the interrupt vector area or the

and no indication what is going on. For instance, a spreadsheet program will undoubtedly contain a bunch of floating-point routines that will appear extremely boring and will not tell you anything of real significance. (If you really want to learn how to write floating-point routines, write a tiny program using floating point in some high-level language, compile it, and then disassemble the compiled listing.)

Programs written in high-level languages will generally be in .EXE format. (Turbo Pascal programs are one major exception.) Assembly language programs longer than 64K bytes will also be in .EXE format. In .EXE programs, code and data are generally in different segments. Disassembling small .EXE programs is usually fairly easy if they have just one code and one data segment.

When you first load the .EXE program into DEBUG, however, you don't know where this data segment is located. The value of CS and IP definitely points at code because that's where the program begins execution. (This does not have to be the beginning of the code segment, however.) But register DS points to the Program Segment Prefix. Generally one of the first things an .EXE program will do is change DS to point to the data segment of the file, so you can determine this address by disassembling a bit of the beginning of the code.

The total size of an .EXE program with a single code and single data segment will be indicated in registers BX and CX when you load the program into DEBUG. If the data segment follows the code segment, you can determine the length of the code segment by subtracting the segment address of the code segment from the segment address of the data segment and multiplying by 16 (i.e., adding a 0 to the end). The length of the data segment is then the total length less the length of the code segment.

If you see numerous areas of code that begin

```
PUSH BP
MOV BP,SP
```

it often means the program was written in a high-level language (such as Pascal or C) and was then compiled. Assembly language programmers usually pass parameters to subroutines through registers. Com-

■ DOS function calls are only one of several signposts you see in disassembled programs.

BIOS data area—also documented in the PC, XT, and AT *Technical Reference* manuals. When DS or ES is set to A000h, B000h, or B800h, the program is directly accessing the video display.

The easiest programs to disassemble are small .COM files with lots of I/O and Interrupt 21h calls. Big programs will contain long stretches of code with no I/O at all

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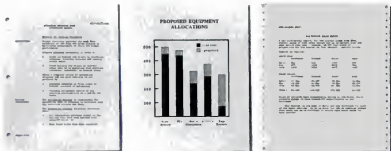
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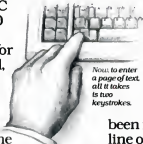
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plers, by contrast, are written to pass parameters by pushing them on the stack. The subroutine then uses register BP to access these parameters.

Disassembling compiled programs is usually more difficult than disassembling assembly language programs simply because they are longer, use memory locations more than registers, and contain code that is more convoluted than the code a human assembly-language programmer would write. On the other hand, disassemblies of compiled programs are more structured, particularly where subroutines and functions are involved, because they won't usually branch from one subroutine to another or use "fall-through" techniques.

RESIDENT PROGRAMS Many of the more interesting and unusual programs today remain resident in memory. You could disassemble such programs like normal programs, but it's sometimes easier to disassemble them after they've been loaded into memory. This is particularly true when the initialization part of the program shifts some code around before it terminates.

Before you load the resident program, however, get a printed listing of the first 256 bytes of the interrupt vector area by executing the following DEBUG command with your printer toggled on (by typing Ctrl-PrtSc or Ctrl-P):

```
D 0:0 100
```

Then get another one after you load the resident program.

Resident programs take control by intercepting interrupt vectors. The difference between the two listings you've just made will tell you which interrupt vectors the program is intercepting. The second listing tells you the addresses of the routines within the resident program that intercept each interrupt.

(Note that DEBUG itself takes control of Interrupts 22h and 23h when it loads, so these will be different even if the resident program does not intercept them.)

Each interrupt vector is 4 bytes long. The bytes are displayed in reverse order. For example, if the resident program you're examining has a "hot key," there's a good chance it's intercepting Interrupt 9,

THE FLEXIBILITY OF ASSEMBLY LANGUAGE

More so than other programming language, assembly language is the language that lets you say the same thing in many different ways. For instance, here's a combination of code you'll see in some programs that get close to the PC hardware:

```
SUB AX, AX
MOV DS, AX
```

This instruction means the program is setting segment register DS equal to 0 and is getting ready to access something in the lower 64K bytes of memory, most probably an interrupt vector address or information in the BIOS data area.

The BIOS data area is documented as segment 40h (which means it begins 1K above the very bottom of PC memory), but the segment:offset addressing system used by the 8088 and 80286 microprocessors allows you to address the same address in many different ways (65,536 of them to be exact).

As an example, the current keyboard shift states are stored at the addresses 0040:0017. But some programs will use 0000:0417, which refers to exactly the same byte. Although I've never seen it done, a program could also use 0020:0217 or even FFFF:0427. In each case the absolute address equals the offset address plus 16 times the segment address.

In the example above, I used

```
SUB AX, AX
```

to set register AX equal to 0. I could also have used

```
XOR AX, AX
```

You'll probably see these two statements more frequently than the simple and straightforward method:

```
MOV AX, 0
```

The SUB and XOR instructions are both shorter and faster than the MOV instruction. They save 1 byte and seven clock cycles, which is equivalent to about 1.5 microseconds (millionths of a second) on a 4.77-MHz PC. Insignificant, you say? Well, much of the art of assembly language programming is involved in saving bytes and clock cycles. They add up.

Tricky programming can speed up programs and create tight code but can also totally obscure what is going on. Here is a famous sequence of code that doesn't seem at all like it should do what it does:

```
ADD AL, 90h
DAA
ADC AL, 40h
DAA
```

If AL contains a value between 00h and 0Fh, this little routine translates it into the equivalent printable ASCII character. The byte 00h is translated to 30h (which is 0) and 0Fh is translated to 46h (which is F).

Not bad for 6 bytes of machine code.

—Charles Petzold

which is the hardware keyboard interrupt. The Interrupt 9 vector address is stored at 0000:0024, because each interrupt vector requires 4 bytes, and 9 times 4 equals 24h. (If you're disassembling the memory-resident *SideKick*, you can use its own calculator instead of doing these hexadecimal multiplications in your head.)

If the 4 bytes at address 0000:0024 look like this:

```
B6 01 7F 19
```

the address of the Interrupt 9 handler within the resident program is actually 197F:01B6. You'll find it easier to disassemble the routines in the resident program if you first set CS (using the Register command) to the segment used by the resident program, in this case 197Fh.

DISASSEMBLING DOS When you need more information about DOS than the DOS *Technical Reference* manual pro-

TRACING THROUGH DOS (AND OTHER DEBUG DISASTERS)

One of the most important rules about using the DEBUG T (Trace) command is that you cannot trace through DOS Interrupt 21 function calls.

Here's why: DOS is not a reentrant operating system. If one program is in the middle of a DOS function call, another program cannot use DOS until that function call has been completed. The most obvious (but not the only) problem is that DOS maintains an internal stack during function calls. A second program that enters DOS before the first one has been completed will use the same area for the stack and write over the contents of the first program's stack. (DOS actually maintains three separate internal stacks, one for function calls 01h through 0Ch, another for function calls 0Dh and above, and a third for function calls 01h through 0Ch during critical errors.)

Tracing through a program making a DOS call runs right up against this reentrancy problem. When DEBUG regains control following a Trace instruction, it displays the contents of the registers. It does this by calling DOS. If the function call DEBUG uses (and it's different depending on the DEBUG version) uses the same stack as the DOS call of the program you're tracing, the original stack will be destroyed.

If you accidentally hit T at an INT 21 instruction, there's no need to immediately panic, however. DOS goes through several instructions before switching to the new stack. So, all you need to do is execute a G (Go) command followed by the address in the program right after the INT 21 instruction. Be sure to use both the segment and offset address in this Go command because the code segment will be different after the INT 21 instruction.

Although you can follow T with a parameter indicating the number of instructions to trace, you shouldn't use it unless you know there will be no DOS calls in the code before the trace has completed.

Here's another piece of code to watch out for:

```
CLI
MOV SP,something
MOV SS,something
STI
```

The programmer is changing the stack pointer (SP) and the stack segment (SS) so that the stack will be at a different location in memory. The programmer has disabled interrupts with a CLI instruction and then enabled them later with STI. Otherwise, if the program happened to be interrupted following the MOV SP instruction (say, by the hardware timer), then the stack, in effect, would be addressed by the old stack segment and the new stack pointer. Where does this point? Who knows? But it could easily write over existing code or data.

The problem is that the 8088 single-step internal interrupt used by the Trace command is not disabled by the CLI command. When this interrupt returns control back to DEBUG after the MOV SP instruction, it will be using an invalid stack.

If you see code like this, execute a G (Go) command to skip over it and break after the new stack has been completely defined. The correct way to write this type of code is

```
MOV SS,something
MOV SP,something
```

When the 8088 microprocessor executes any instruction that changes a segment register (such as SS), it disables all interrupts—including the single-step interrupt—until after the next instruction. If you enter a T (Trace) at the MOV SS instruction, you'll actually regain control at the instruction following the MOV SP instruction. That way both the stack segment and stack pointer have been changed without interruption.

—Charles Petzold

vides, disassembling DOS itself is one way to get it. It's also an extensive project. My disassembled listing of DOS 3.1 runs to about 200 pages for the IBM DOS module and another hundred for COMMAND.COM.

To find where DOS is located in memory, boot up without loading in any resident programs and use DEBUG to see where the Interrupt 21h vector points. It's the 4 bytes stored at 0000:0084. When you disassemble the code for the Interrupt 21h handler (as shown above for INT 9), you'll find it uses the value of AH to look up an address in a "dispatch table." This table contains the address of all the DOS function calls. When you get the whole listing of DOS on paper, you can use this dispatch table to find where each function call begins.

You'll find that function calls within DOS tend to call and jump to routines that are scattered throughout the listing with no apparent rationale or order. After spending much time attempting to annotate a disassembled DOS, I wasn't surprised to learn that Microsoft uses a "code scrambler," which randomly mixes up the order of routines within a program. Maybe Microsoft doesn't want us to disassemble DOS. Well, that's too bad.

UNDOCUMENTED DOS CALLS

Some of the interrupts and function calls you find in a disassembled DOS are not documented in the DOS Technical Reference manual. To find out about the uses of undocumented DOS calls, the best programs to look into are those that do magic things—things that just don't seem possible, based on the regular DOS technical documentation.

CHKDSK, for instance, is able to determine the layout of any block device (any storage device organized with a directory and a FAT, such as a disk or some tape backup systems) installed as a device driver, no matter how unusual it is. Where's the DOS function call that provides that information? (See Programming/Utilities, PC Magazine, Volume 5 Number 8.)

PRINT is a resident program that gets around the DOS nonreentrancy problem (see sidebar, "Tracing through DOS [and other DEBUG Disasters]) to access the disk. There's lots of undocumented stuff

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there. (See PC Tutor, *PC Magazine*, Volume 4 Number 21.)

And DEBUG itself does some strange things—like jumping back and forth between parent and child processes with no apparent problems.

Sometimes it's possible to determine what an undocumented function call does simply by the use of it within one of these programs, but usually you have to go into DOS to see what's happening on the other end. Often, the implications are more hidden. For instance, Function Calls 50h and 51h set and get the "Current Program Segment Prefix" (PSP). Use of these calls allows DEBUG to switch between parent (DEBUG) and child (program being debugged) processes. However, within DOS these two calls simply retrieve or save this address. It's only when examining memory allocation or file I/O calls that the full implications of this Current Program Segment Prefix become apparent: it turns out that the owner of an allocated memory block or the open file handle is the program whose PSP is stored in DOS as the Current Program Segment Prefix.

SHORT CUTS I One popular use of DEBUG is to make patches to programs to fix bugs or correct other undesirable behavior. Finding the place to patch often does not require a complete disassembly but can be done just by using the DEBUG S (Search) command.

For example, one very popular spreadsheet program (now no longer sold because the company has a second release out) had a nuisance kind of copy protection that required you to put the original distribution disk in drive A: to start it up. It was a rather primitive form of copy protection and a lot of people found easy fixes, which are still listed on many computer bulletin boards. With this fix, the program could be installed on a hard disk where users could definitely get \$495 worth of hassle-free use from it.

How did so many people find the fix? Just a little common sense. And DEBUG, of course.

Since the key disk pretty obviously had a funny track on it with more than the normal eight sectors, the program probably checked for the existence of these sectors by accessing the disk through the BIOS

CASE STUDY: A COLORFUL CLS

How to patch COMMAND.COM so that it colors the screen when you type CLS.

The hardest part of patching existing programs is determining where the patch should go. You really have to make an intelligent guess about the functioning of the program.

As an example, let's attempt to modify COMMAND.COM so that it colors the screen on a CLS command. As with any type of patch, try it out on a copy and not the original.

First, think about what we should look for. CLS is different from all the other DOS internal commands. It is the only internal command that does something to the screen other than just write to it with simple teletype output. CLS blanks the screen and homes the cursor. Since it can't do this through DOS calls (unless ANSI.SYS is loaded), it is probably calling the BIOS directly. The BIOS Interrupt 10h call controls the video, and so the CLS command probably uses several INT 10h instructions. The machine code for INT 10h is CDh 10h.

(While this same method will work under any version of PC-DOS, Version 2.0 and later, the addresses I'll be using are from PC-DOS 3.1. Other versions of PC-DOS (or MS-DOS) will have different addresses; you should be absolutely certain that you're using the correct addresses.)

Load COMMAND.COM into DEBUG:

```
S 100 FFFE CD 13
```

disk call, Interrupt 13h. The machine code for an INT 13h is CD 13. So, to find where the program called the BIOS disk routine, you can just load the program into DEBUG and do a Search command:

```
S 100 FFFE CD 13
```

and DEBUG will display the address where these bytes are located. (Of course, when DEBUG prints out such an address, it doesn't necessarily mean that it points to

```
DEBUG COMMAND.COM
```

and do an R command. The size of COMMAND.COM is in register CX. For DOS 3.1's COMMAND.COM, this value is 5AAAh.

Now do a Search command to look for the CDh 10h bytes:

```
S 100 L 5AAA CD 10
```

You'll get a list of six addresses, all clustered close together. The first one is 261Dh. You can now pick an address a little before that (to see what the first call is doing) and start disassembling:

```
U 261B
```

The first INT 10h has AH set to 0Fh, which is a Current Video State call. The code checks if the returned value of AL (which is the video mode) is less than 3 or equal to 7. These are the text modes. If so, it branches to 262Ch. If not, it just resets the video mode with another INT 10 at address 2629h.

At 262Ch, the code first sets the border black (the INT 10 at 2630h), then does another Current Video State call (at 2634h) to get the screen width in register AH. It uses information from this call to set DX equal to the bottom right row and column. It then clears the screen by scrolling the entire screen up with another INT 10 (at 2645), and then sets the cur-

piece of code. A particular sequence of 2 bytes together like CD 13 has a 1 out of 65,536 chance of occurring in random data. Or it could be an address or another piece of instruction.)

For .EXE programs larger than 64K bytes, you may have to do multiple Search commands, for each one can cover only 64K. In that case, just add 1000h and the contents of register DS together and explicitly preface the first address with this

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sor to the zeroth row and zeroth column with the final INT 10 (at 264Dh).

When it scrolls the whole screen, the zero value in AL, actually means blank the screen. The value of BH is the attribute to be used on the blanked area. In an unmodified COMMAND.COM, BH is set to 7 (which is white on black) by the following statement at address 2640:

```
MOV BX, 0700
```

If you prefer a yellow-on-blue attribute (1Eh), you can change this line by going into Assemble mode by entering

```
A
```

then entering

```
MOV BX, 1E00
```

and exiting Assemble mode by entering a blank line.

Now you can save the modified file:

```
W
```

and quit DEBUG:

```
Q
```

When you load the new version of COMMAND.COM (and you can do so without rebooting by just entering

```
COMMAND
```

on the DOS command level), a CLS will turn the screen blue and display characters as yellow.

If it doesn't or if anything you type shows up as white on black, that probably means you have ANSI.SYS loaded. If you use ANSI.SYS, you don't have to make this patch but can instead use the PROMPT command for coloring the screen.—Charles Petzold

segment address.

Once you find the address where the offensive bytes occur, you can then disassemble just that short section. (For .EXE programs, watch out—the Search command is based on the DS segment while Unassemble is based on CS.) For this particular spreadsheet program, this disassembly revealed what the program was doing with these INT 13 instructions, what it was expecting to see on the disk, how it re-

acted if it didn't find it, and what might be done to skip all this nonsense.

When you're going to patch an .EXE program, the first thing you must do is to rename it so it doesn't have an .EXE extension. DEBUG throws away the .EXE header when loading an .EXE file and thus doesn't allow it to be saved back onto the disk. Without the .EXE extension, DEBUG loads the whole file, header and all, starting at offset 100h. You will have to do another Search command to find out where the code ended up. When you're finished making patches with the Enter or Assemble commands, you can write the program back out to disk with the W (Write) command and then rename it back to the .EXE extension.

Of course, copy-protection schemes have become much more sophisticated since 1983, and so such an easy solution is unlikely these days. However, the same methodology still holds for fixing other types of bugs or annoyances in programs.

For instance, if a program makes your screen colors something you don't care for, you could search for the 2 bytes CDh 10h, because these are the Interrupt 10h BIOS video call.

SHORT CUTS II The DEBUG G (Go) and T (Trace) commands allow you to monitor the execution of a program by breaking at a particular address or by single-stepping through instructions. The Go command is usually entered followed by a breakpoint address. DEBUG replaces the contents of this address with a Breakpoint Interrupt (the 1-byte machine code CCh). When this breakpoint is executed, control returns back to DEBUG, which then puts the original byte back in. The Trace command entered by itself executes one instruction and then returns control. In each case DEBUG displays the contents of the registers and the next instruction that it will execute.

If a program does something that you'd like to learn more about, you can use these two instructions to find the particular area where what you're interested in happens.

This technique can be used only for normal, nonresident programs. Even in normal programs, you cannot trace through Interrupt 21h calls. This is because Interrupt 21h is nonreentrant. DEBUG is also

making Interrupt 21h calls to read the keyboard and write to the display, and that's no good when somebody else is using Interrupt 21h. When you are about to execute an Interrupt 21h (as indicated by the INT 21 in the Trace display), add 2 to the value of the IP (instruction pointer) register, and enter G (for Go) followed by that address. You'll regain control when the Interrupt 21h has finished. Or, if you have DOS 3.0 or later, just enter a P (Proceed). This does the same thing.

You can usually trace through ROM BIOS calls, but you cannot use the P or G commands in ROM unless the G command is followed by an address that is not in the ROM. Both these commands work by writing the 1-byte Breakpoint Interrupt machine code instruction into memory and obviously that won't work with read-only memory.

Let's suppose you have a program that beeps at some point and you'd like to disable the beeping. Think of the program as a series of nested subroutines. The program begins, it executes a few subrou-

■ Finding the place to patch a program often does not require a complete disassembly but can be done just by using the S command.

times, and then it terminates. Each of these subroutines, in turn, may execute other subroutines. One of these subroutines beeps and you have to find it.

(I'll be using the Proceed command in this example. If you have DOS 2.x, you'll have instead to take the contents of the IP register, add to it the length of the instruction, and enter G followed by that number. The length of the instruction is equal to the number of two-digit bytes that are shown on the bottom line of the register display following the address of the instruction.)

Load your program into DEBUG and

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start to single-step through its instructions by repeatedly entering T. When you get to an INT instruction, enter P. When you get to a CALL instruction, write down the address where the CALL occurs (at the far left on the bottom line of the register display) and enter P. If the beep does not occur during the execution of that subroutine, keep going with T commands. If the beep does occur, enter a plain G (which executes without breaking), exit the program and exit DEBUG. Now reload the program into DEBUG, enter a G followed by the last address you wrote down. This brings you to the subroutine whose execution caused the beep. Now, instead of using the P command, use T to trace through the subroutine. You've gotten one level deeper. Now you can use P to execute without tracing any nested subroutines within this subroutine, each time writing down the address where you do this. When one of these subroutines beeps, again just finish up the program with G, exit DEBUG, and restart it.

Each time you do this, you're getting one level closer to finding that beep. The program could be beeping in any one of several ways (writing an ASCII 7 to the display through DOS or the BIOS Teletype routine or manipulating the 8253 timer chip directly through OUT instructions). It'll help if you try to think of all the ways the program could be beeping so that you know what you're looking for.

THE CAVEATS None of the methods I've described will work with every program. For instance, some high-level languages have functions to call BIOS interrupts that construct an Interrupt instruction and execute it instead of including the Interrupt instruction directly in the code. Searches for the Interrupt instruction will not work.

Using the P (Proceed) command to execute subroutines will not work with programs that store data following the CALL statement. (ROM BASIC and Turbo Pascal programs do this.) The subroutines in these programs know the data is there and adjust the return address on the stack to accommodate it. The DEBUG Proceed command won't know about this little problem. Programs that load other programs with EXEC calls also present problems be-

SYMDEB: A STEP UP FROM DEBUG

The SYMDEB symbolic debugger that comes with Microsoft's Macro Assembler, Version 4.0, is a big improvement over DEBUG for disassembling programs.

If you would like something more powerful than DEBUG, the SYMDEB debugger (included with the Microsoft Macro Assembler, Version 4.0) is ideal. SYMDEB is a superset of DEBUG; if you know DEBUG, you know SYMDEB. However, SYMDEB gives you so many more functions than DEBUG that once you start using it, you'll never go back.

For instance, DEBUG's D (Dump) instruction displays a table of hexadecimal bytes. SYMDEB supports D but also adds DW (Dump Words), DD (Dump Double Words), DA (Dump ASCII string), DS (Dump Short Reals), DL (Dump Long Reals), and DT (Dump Ten-Byte Reals). These last three show decimal equivalents of floating-point numbers stored in the three formats supported by the 8087 math coprocessor chip. SYMDEB has a whole set of Enter commands that function similarly.

To display interrupt vector addresses with DEBUG, you would enter

D 0:0

and then read off each set of 4 bytes backwards to convert them into segment and offset addresses. With SYMDEB, you can simply enter

DD 0:0

and SYMDEB will display the data in segment:offset fashion.

SYMDEB also supports arithmetic expressions. If you want to see the address of Interrupt 9, you don't have to do a hexadecimal multiplication of 9 and 4 in your head. Instead, you can use

DD 0:9*4 L 1

You can also use registers in these expressions. To search through an entire .COM file for a particular sequence of

bytes with DEBUG, you first have to get the value of register CX, which is the size of the program, and use that in the Search command. SYMDEB lets you use CX directly:

S 100 L CX (whatever)

During traces with the T command, SYMDEB will display an English description of the function call (based on the value of AH) whenever it encounters an INT 21 instruction.

SYMDEB will also refuse to trace through a DOS function call. If you enter T at an INT 21 instruction, it will return control at the following instruction just as if you had entered P (Proceed).

SYMDEB's real value is revealed when you're debugging your own programs. As its name implies, SYMDEB is a symbolic debugger. This means it can display names you've used in your program where DEBUG displays only memory addresses. With programs compiled under Microsoft's C, Pascal, and FORTRAN compilers, SYMDEB can even display your source code along with the disassembled machine code.

—Charles Petzold



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cause you don't know where the program will be loaded. You have to be careful with overlays as well.

I've also recently encountered some .EXE programs that have been "packed" using the EXEPACK utility written by Microsoft and included with its Macro Assembler and C Compiler. (You can probably guess which software company has been shipping these packed programs.) EXEPACK can make many .EXE files smaller by compressing strings of repeated

■ Disassemblies will be impossible when a program is encrypted in some way. The code and data will look like junk.

bytes. It then adds some code to the .EXE file that decompresses it after it's been loaded. Getting past this loader into the guts of the program is a real nuisance, and, as far as I know, an UNPACK program does not yet exist.

Disassemblies will be impossible when the program is encrypted in some way. Both code and data will look like junk. You'll have to trace it past the decryption to make any headway.

One such program I tried tracing kept going through a loop that disabled the single-step interrupt used for the trace. The code that disabled this interrupt couldn't be changed because it was used (as data) for the decryption logic. I gave up on that one—I decided the program was junk.

But even so, every time I've used DEBUG to do some exploring, I've learned something. Even if I don't get to where I set out for, I always see some neat things along the way. [Editor's note: For information on software products that help you edit programming code, see "Easier Than DOS DEBUG: Six Utilities for Byte-Level Editing" in this issue.]

Charles Petzold is a contributing editor of PC Magazine.

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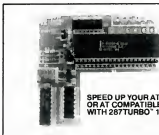
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DOWNLOADING POP-CAL

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The modem number for PC-IRS is (212) 696-0360. Set your modem and communications software to use 1200 (or 300) bps, 8 data bits, 1 stop bit, no parity. PC-IRS files with a .COM, .EXE, or

.ARC extension require that you also use the Xmodem error-checking protocol; our other files (e.g., with extensions of .ASM or .BAS) can be downloaded using either regular ASCII or Xmodem transmission.

POP-CAL.BAS, whether typed in from the magazine at your keyboard or downloaded from PC-IRS, will automatically create POP-CAL.COM when run once in BASIC. POP-CAL.ASM, also listed both here and on PC-IRS, allows you to modify the program but requires that you use a macro assembler (IBM or Microsoft) and the following commands:

MASM POP-CAL;
LINK POP-CAL;
EXEBIN POP-CAL POP-CAL.COM

POP-CAL.COM AT A GLANCE

Syntax:

[d:] [path] POP-CAL

Operations:

<Alt-C> Toggles calendar on/off
<Right-Arrow> Ahead one month
<Left-Arrow> Back one month

<Up-Arrow> Ahead one year
<Down-Arrow> Back one year

Notes:

POP-CAL.COM is a memory-resident program and normally is loaded through your AUTOEXEC.BAT file.

—Craig L. Stark

control the years directly; if you try to go back before 1583, the Down Arrow key is ignored. All keystrokes, except the four cursor keys and the Alt-C keys, are ignored while the calendar window is on the screen. This includes all the numbers on the numeric keypad, so make sure that the NumLock key is not on if the calendar fails to respond to the cursor keys.

POP-CAL will run just as fast as you can send the cursor keystrokes, but that is only about a decade per second at standard keyboard settings. (You can run through about a century every 4 seconds if you have one of the high-speed typematic utilities installed.) For convenience, especially when pursuing distant dates, POP-CAL starts with the current month only upon the initial call. After that, the first calendar

popped up will be the last one examined earlier in the session.

CHANGING THE POP KEY The Alt-C key combination was chosen for purely mnemonic reasons ("Alternative Calendar"). Other programs you use may already require this key pair, or you might yourself already be using it to call one of your I-2-3 keyboard macros. In such a case, it's easy enough to modify POP-CAL to use another letter or combination of letters.

If you're working with the POP-CAL.ASM listing shown in Figure 1 and want to use a new trigger key, alter the "scan_code" value, which is currently set at 2E00h. If you are working with the POP-CAL.BAS listing, you will want to change

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CBS	Nov-13-84	230	84	119.14	7,912.20
CBS	Sep-10-85	100	100	119.14	1,914.00
CBS	Sep-10-85	100	100	119.14	1,914.00
CV	Aug-1-87	50	22.12	47.18	1,259.00
CAC	Aug-10-85	100	100	119.14	1,914.00
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now_busy:
mov     v, busy, 1      ;Set busy flag, to protect our stack.
mov     v, savas, ss    ;Save caller's stack segment.
mov     v, savap, sp    ;Save caller's stack pointer.
mov     sp, cs
cli     ;Avoid interrupt right now.
mov     ss, sp          ;Reset stack to our code segment.
mov     sp, offset v.rom16h ;Start our stack below ROM16 addr.
sti
push    ax
push    bx
push    cx
push    dx
push    hp
push    si
push    di
push    da
push    aa
;Save all user's registers.
call    begin_calendars ;Go do the calendars.
pop     aa
pop     di
pop     si
pop     hp
pop     dx
pop     cx
pop     bx
pop     ax
;Restore all user's registers
cli
mov     ss, v.savas     ;restore old stack
mov     sp, v.savap
sti
mov     ah, 8           ;Reset AH to BIOS key read function.
mov     v, busy, 0      ;Allow reuse of calendar stack.
jmp     getkey          ;Go get new key from BIOS.
;----- Read keys input. Process calendars. -----
begin_calendars:
push    cs
push    ds
pop     ds
pop     cs
;Set DS and ES to our code segment.
cld
sasmma  da:csseg
call    wndo
showcal showcal
mov     v, month, dh
mov     v, year, cx
fill    fill
input:  mov     ah, 8
int     16h
cmp     sz, acen_code
jna     getdata
ret
getdata: mov     dh, v.month
mov     cx, v.year
trylft: cmp     ah, 75
tryrgt: tryrgt
dec     dec
jnc     jnc
mov     mov
dec     dec
jmp     jmp
tryrgt: cmp     ah, 77
tryup:  tryup
inc     inc
cmp     cmp
dh, 11
jng     jng
mov     mov
dh, 8
inc     inc
jmp     jmp
chblyr  chblyr
ah, 72
tryup:  cmp

```

(Figure 1 continues)

the fifth number on line 430 (currently 46), along with the row total for that line (the last number on the line) and the grand total checksum on line 270.

A handy source for some possible key combinations may be found in the IBM BASIC manual that comes with your machine. From its Extended Codes table you can see, for example, that Alt-D has a second code of 32. This could be used in place

of the 46 on line 430 to convert the trigger key from Alt-C to Alt-D. Scanning further down the page, you'll see that replacing the 46 with 119 would convert the Alt-C to Ctrl-Home.

When altering the 46 on line 430 of POP-CAL.BAS, you must also change the 772 at the end of the line and the 96431 on line 270. For instance, if you are converting to Alt-D, substitute 32 for the 46. Then

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jne      trydwn          ;If not, see if was a down key.
inc      if op, incrcase year by 1.
chkhlyr: cmp             ;Year can only be 4 digits.
         jge             ;Ignore key, if date goes out of range.
         jmp             ;Otherwise go make new calendar.
trydwn:  cmp             ;Down arrow? (decrease year)
         jne             ;If not, ignore key and go get new one.
         dan             ;Down key reduce year by 1.
chkhlyr: cmp             ;Calendar calculations only good for 11/1582
         jle             ;on, so ignore key, if year now < 1583.
         jmp             ;Otherwise, go make new calendar.
         nstal
;----- Fill in the new calendar -----
fill:    call            firstday          ;Calculate weekday of 1st of month.
         mov             aa,v.video_seg    ;Point ES to write to screen.
         mov             cb,v.mnth        ;Put current month into AL.
         cwr             ;Clear out AL.
         mov             cx,3             ;Zero out CX. Put 3 in CX.
         mul             cx              ;AX = 8 bytes to current month's name
         mov             al,offset month; from start of "months".
         add             si,es           ;SI=offset to month's name
         mov             di,v.crt_cole    ;Put screen width (8 columns) in DI.
         add             di,v.left        ;Move to left edge, second row.
         add             di,22           ;Move on to center month in the row.
         mov             movname:lodsb    ;Load character from month's name.
         call            writebyte        ;Output char of month's name to screen.
         loop            movname          ;Do three times, since cx=3.
         add             di,2            ;Skip a space, after the month's name.
         mov             mov,sv.year      ;Load year into AX.
         div             bl,100          ;Will use to split year into centuries.
         mov             bh,1            ;portion and remaining years in century.
         call            unpack          ;Set flag, so will retain leading zero.
         mov             al,ah           ;Display the centuries portion of year.
         call            al,ah           ;Put remainder in al.
         mov             setdi: mov       ;Display remaining 2 digits in year.
         mov             aa,v.crt_cole    ;Load current screen width.
         mul             bl,4            ;Mult by 4 rows to skip.
         add             di,4            ;Calculate offset to 4th row of calendar.
         add             di,v.left       ;Skip in 2 columns on that row.
         add             di,es          ;Set to offset of top left corner of calendar.
         mov             di,es          ;Move to location of 1st date on screen.
         mov             di,v.weekday    ;Retrieve week day of 1st of cal's month.
         mov             cl,dl           ;Store as count of days to blank in let week.
         mov             dh,6           ;DH = 6 weeks left to fill in.
         jnz             start_current_month ;If Sunday, CX = 6 and no blanking needed.
         mov             blnkwl:cell      ;Blank out 1st part of let week.
         loop            blnkwl
         mov             start_current_month:
         mov             cl,7           ;Number of days to display in let week
         sub             cl,dl          ; = 7 - weekday of 1st day.
         mov             h1,v.mnth       ;Set index for days-per-month array.
         mov             bh,bh          ;Set flag to suppress leading zeroes.
         mov             dl,numdays[hl] ;Set 6 days in current month.
         mov             al,1           ;Set AL to 1st day of month.
showdays:
         call            unpack          ;Format and display the date value.
         inc             al             ;Increment to next day.
         add             di,4           ;Skip to next day position.
         dec             dl             ;Reduce 6 days left in month.
         jmp             blnkret        ;If last day, blank rest of the 6 weeks.
         loop            showdays      ;Otherwise continue displaying dates in week.
         call            natweek        ;When reach end of a week, space to next one.
         jmp             showdays      ;end continue on new row of calendar.
         call            blnkret        ;Blank out remaining days in week.
         loop            blnkret        ;Blank to end of current week.
         call            natweek        ;Allocate DL to 1st day of next week.
         jmp             blnkret        ;If not past last week, go blank week out.
         push            cs             ;When all done, restore ES to CS.
         pop             ee
         ret
;----- Return to keyboard reading routine -----
natweek: add             di,v.left       ;Return to 1st date in next week in row of calendar.
         ;Move to left edge of next row of calendar.

```

(Figure 1 continues)

change 772 to $(772 - 46 + 32)$, i.e., to 758, so that the row adds up properly. Similarly, change the 96431 on line 270 to 96417 $(96413 - 46 + 32)$ so that the last number of all the data lines will still add up to the right checksum.

Of course, alternatively, once you've created POP-CAL.COM, you can use DE-BUG to alter the trigger by changing the byte at address 174.

You can use POP-CAL without becoming involved with any further technicalities, but if you want to learn how the program works, you'll be interested in the following considerations.

FINDING THE DAY OF THE WEEK The Gregorian calendar is only slightly more difficult to generate than the Julian if time is restricted to after 1582.

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```

add    di,4           ;Move in an additional 2 columns.
mov     cl,7           ;Restart week count.
dec     dh             ;Reduce weeks left in calendar.

;----- Computes weekday of last day of month -----
firstday:
mov     si,v-year      ;Hold year in SI, of quick access.
mov     numdays[1],28 ;Assume this isn't a leap year.
test    si,3           ;Now see if year divisible by 4.
jnz     getday         ;If not, was actually not a leap year.
feb29:  mov     numdays[1],29 ;Else was leap year with 29 days.
getday:  mov     ba,6     ;BX=Saturday, (weekday of 1/1/1583)
mov     ss,si          ;Calendar year to AX.
mov     ss,1583        ;Calc. # years since our base year.
add     ba,ss          ;Calendar advances 1 weekday per
                        ;year unless leap years intervene.
add     ss,2           ;Adj diff, so even #, if the calendar
                        ;year was year after a leap year.
cwr     cx,4           ;Saro out DX.
div     cx             ;Calculates # leap years before this.
add     ba,ax          ;Add 1 day to week, for each leap yr.
cmp     si,1700        ;Things work normally 'till 1700, which
cwr     cx             ;not a leap year, per Gregorian cal.
mov     ss,si          ;Year back to AX, again.
sub     ss,1600        ;Get # years since 1600.
mov     cl,100         ;Convert to number of centuries.
cwr     cx             ;If remainder=0 this is centennial yr.
div     cx             ;if century is evenly divisible by
                        ;400, it is also still a leap year.
test    ss,3           ;Other centennial years have 28 days.
jnz     numdays[1],28 ;if centennial yr, sub 1 from centuries
deduct:  sub     ba,ss  ;Subtract 1 weekday per century.

mov     cl,4           ;Calculate centuries mod 400.
div     cx             ;Add back 1 day per 400 years.
add     ba,offset numdays ;Add in # days per month, this yr.
cwr     cx             ;First clear hi byte of accumulator
mov     ax,ah          ;Load ax with month counter
mov     cl,v-mnth     ;if January, srs ready for final calc.
jcxz    final          ;Get low byte into accumulator.
add     ba,ss          ;Add to 0 day count.
loop    addmonth       ;Continue until prior months added in.
final:  mov     ax,4    ;AX=4 days advanced since 1/1/1583.
mov     ss,ba          ;Clear out DX.
cwr     cx             ;Find # full weeks since 1583.
div     cx             ;DX=weekday of 1st of calendar's month
mov     v,weekday,dl   ;Save results of this work.

;----- Convert binary # in AL to ASCII and output to ES:DI -----
unpck:  push     bx
push     bx            ;(AL should binary # from 0-99.)
mov     bx,ax          ;Divide al by 10.
sar     bx,1           ;Convert digits to ASCII.
mov     ah,30b        ;See if 10's digit was a saro.
cmp     ah,30b        ;If not, go output it to screen.
jnz     putnum        ;If 99=1, leading zero is ok, so
                        ;go write it. Otherwise, replace
                        ;leading saro with a blank.
putnum: mov     bl,al   ;Need to write high order digit first.
mov     al,ah          ;so save low digit and move hi into AL.
call    writebyte     ;Output 10's digit to screen.
mov     al,bl          ;Put 1's digit back in AL.
call    writebyte     ;Writes 1's digit.
pop     bx            ;Restores BX.
pop     ss            ;Retrieves old binary value.
ret                 ;All done.

;----- Blank out 2 digit calendar data field. Updates DI -----

```

(Figure 1 continues)

Since there are 365 days per non-leap year and only 364 days in 52 weeks, the first day of the year advances one weekday per year. Thus, since January 1, 1583 was a Saturday, January 1, 1584 was a Sunday, etc. Further, since leap years have an extra day, the weekday of the first of each year following any leap year must advance 2 days. Hence, the first day of any year after 1583 can be calculated by adding the num-

ber of years since 1583 to the weekday of January 1, 1583, and then adding in an extra day for each leap year. The resultant sum, when divided by 7, yields the weekday of the start of any year, where Sunday produces a remainder of 0 and Saturday has a remainder of 6.

The only twist in the above logic is that Pope Gregory declared that all centennial years would *not* be leap years unless they

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```
blank2: mov     cl,28h          ;Put a blank in AL
        call    writebyte      ;Write a blank over 1st digit.
        call    writebyte      ;Write a blank over 2nd digit.
        add     dx,4           ;Skip 2 spaces, to next date.
        ret

;----- Write char AL on screen at ES:DI. Update DI. -----
writebyte:
        push    dx             ;Save DX.
        mov     dx,v.status_port ;Point to video status port address.
        mov     ah,al          ;Move character to AH, for now.
on1:    in       al,dx          ;Wait until not doing a
        test    al,1           ; horizontal scan retraces.
        jna     on1
        cli
on2:    in       al,dx          ;Now wait until next horizontal
        test    al,1           ; retraces begins, so KNOW will have
        je      on2            ; entire retracing time period to work.
        mov     al,ah          ;Retrieve character from AH.
        stob    dx             ;Store character on screen.
        sti     di             ;Skip over attribute byte on screen.
        inc     di             ;Restore old DI value.
        pop     ret

;----- Switch memory field with screen date -----
wndo:   call    getprms        ;Get current video parms
        mov     dx,v.status_port ;Point DX to Status Port.
        sub     dx,2           ;Back up to control port.
        mov     ee,bios        ;Point to ROM BIOS date segment
        mov     bh,es:[65h]    ;Get current setting of video card.
        mov     al,bh          ;Move to AL, for output, after retest.
        out     dx,al          ;Turn off video enable bit only.
        out     dx,al          ;Turn off screen.
        mov     di,v.left      ;Point to calendar date in memory.
        mov     ee,v.video_seg ;Set DI=upper left corner of calendar.
        mov     hl,1l          ;Get ES to video buffer segment.
        mov     cx,38          ;All rows in the calendar.
natlin: mov     ecx,es:[di]     ;There are 38 words per calendar row.
getchr:  mov     [di-2],ax      ;Get next word from screen buffer.
        mov     [di],ax        ;Move data word to screen.
        mov     [di-2],ax      ;Store screen character in our date.
        loop    getchr         ;Continue across row.
        add     di,v.left      ;Move to start of next calendar row.
        dec     bl             ;Reduce row-to-go count.
        jnz     natlin        ;Do next row, if more to go.
        mov     al,bh          ;Restore video setting to original
        out     dx,al          ; and turn on screen again.
        mov     cx,es:[di]     ;Restore ES to our code segment.
        pop     ret

;----- Get video display parameters -----
getprms:push    es
        mov     es,bios        ;Point ES to BIOS date segment.
        mov     ex,es:[4ah]    ;Put current column width.
        shl     ex,1           ;Multiply by 2, for attribute bytes..
        mov     v.ort_cols,ex  ;Store in our date, for easy access.
        sub     v.ort_cols,ex  ;Back off from right side, by width of
        mov     v.left,ex      ;calendar. Equals offset to left edge.
```

(Figure 1 continues)

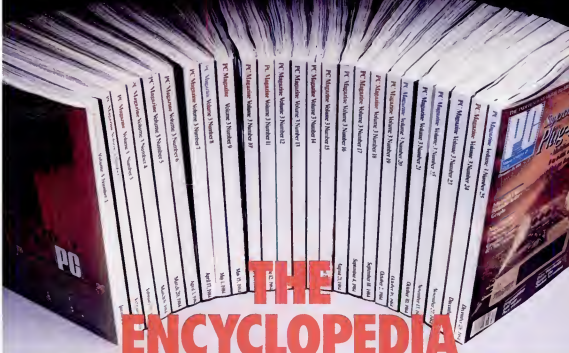
were evenly divisible by 400. Thus 1900 was not a leap year but 2000 will be. This is handled in the code by calculating the number of intervening centuries, subtracting this number from the sum above, and then adding back 1 day for each 400 years.

Once you have calculated the first day of the year, finding the first day of the month requires only that you know the number of days in each preceding month. You then add the days between the first of the year and the first day of the subject month to the sum from above and divide this total by 7. A remainder of 0 means the month begins on Sunday, etc.

DESIGNING THE POP-UP FUNCTION Essentially there are three fairly common techniques used to activate pop-

up routines: checking the keyboard flags once each half-second or so, intercepting the keystroke interrupts when keys are struck, and intercepting keys as they are passed to requesting programs. The third of these methods is the simplest and is perfectly adequate for routines that are not time-critical.

POP-CAL, when loading, substitutes the address of its "int16h" routine for that previously found in the system interrupt table located at the bottom of memory. This substitute routine allows POP-CAL to monitor each request from a user program (including DOS) for a new key from the keyboard buffer. By examining the returned key first, POP-CAL can then decide whether to use the key itself or pass it along to the calling program.



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mov ax,es:[43h] ;Get base address of video card.
add ax,6 ;Calculate status port address and
mov v,estatus_port,ax ;save for checking horic ecome.
mov v,hllite,79h ;Blank on white background.
mov hl,es:[49h] ;Get video mode into hl.
cmp hl,7 ;In Monochrome video mode?
jnz eeg0000h ;Monochrome buffer seg at 000000h.
jnz eeg0000h ;if monochrome, go store video seg.
mov test,hl,1 ;if graphics card, video seg=000000h.
jnz eeg0000h ;,3 are color text on graphics card.
mov v,hllite,1fh ;Use bright white on blue, if color.
setseg: mov v,video_seg,es ;Store video segment value
pop ;Restore 16.
ret ;Done.

;----- Create calendar form and become resident. -----
Install: call getprss ;Call, to get correct color attribute.
mov di,offset data_etr ;Point to end of our code segment.
mov ah,v,hllite ;Set attribute byte in AH.
mov al,20h ;Will store blanks in calendar area.
mov cx,11*30 ;11 rows of 30 columns each.
rep utows ;Blank out calendar work area
push di ;Save end of calendar offset.
mov si,offset days ;Now store day's names in calendar.
mov bl,7 ;Set names-to-go counter to 7.
mov di,offset data_etr ;Point to start of calendar.
add di,3*8*2+4 ;Skip in 3 rows + 4 columns.
movday: mov cx,3 ;There are 3 chars per name.
movchr: movsb ;Transfer character into calendar.
inc inc movchr ;Skip over attribute byte.
loop loop ;Continue for three characters.
inc inc ;Add 2 to DI, to skip space.
dec dec ;Reduce names-to-go count.
jnz movday ;Continue until all stored.
mov ah,2ah ;Get current date from DOS.
int 21h ;Convert month, to Jan=0, etc.
dec dh ;Save month end year values.
mov v,mnth,dh
mov v,year,cs
go_resident:
xor ax,ax ;Set ES to 0.
mov es,ax ;Store rom interrupt 16h address.
mov ax,es:[16h*4]
mov v,rom16h,ax
mov ax,es:[16h*4+2]
mov v,rom16h+2,ax
mov ex,offset int16h ;Point Interrupt 16 to our code.
cli ;Point Interrupt 16 to our code.
mov es:[16h*4],es
mov es:[16h*4+2],cs
eti ;Retrieve address of end of data.
pop dx ;Now become resident.
int 27h

;----- Calendar data area -----
data_etr equ this word
cseg ends
end begin

```

(Figure 1 ends)

TWO STANDARD READ ROUTINES

Interrupt 16h has two standard read functions. If AH=0, this BIOS read routine simply begins looping and waits for a key to become available in the keyboard buffer. As soon as one is typed in at the keyboard, the routine removes the key from the buffer and returns it to the caller in the AX register. However, if AH=1, the BIOS routine reads ahead in the buffer, returning the next key (if it exists) in AX without removing it from the buffer. The user program then decides whether or not AX has a valid key by checking the setting of the empty buffer (zero) flag.

Some commercial desktop programs monitor both the "read-ahead" and the "wait-for-key" calls to Interrupt 16h. While this may result in a quicker response

■ There are three techniques to activate pop-up routines. Intercepting keys as they are passed to requesting programs is simplest.

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buffer, it also requires about 40 additional bytes of code and is not reliable enough for use in truly time-critical routines, such as might be used for controlling the output to a printer.

Since monitoring the read-ahead function yields only spotty and unreliable improvement in response time, POP-CAL checks the results of only the wait-for-key calls. Meanwhile the read-ahead calls, like the keyboard status calls, are simply ignored and are passed along for processing without further ado.

PROCESSING THE TRIGGER KEY

When a user program issues a wait-for-key call, POP-CAL pushes the processor flags onto the stack and calls the old key-reading routine that it has replaced. This forces the old routine to return to POP-CAL instead of to the caller routine when done and allows POP-CAL to decide what to do next.

When control is returned to POP-CAL, the program first checks the new key in AX against its 2-byte trigger key code. If both bytes in AX match the stored trigger key, all the caller's registers are saved and

```

100 REM -- BASIC PROGRAM TO CREATE pop-cal.COM
110 OPEN "pop-cal.COM" AS #1 LEN = 1
120 FIELD #1,L AS A$
130 CHECKSUM = 0
140 FOR I% = 1 TO 110
150 LINESUM = 0
160 FOR J% = 1 TO 8
170 READ B$
180 CHECKSUM = CHECKSUM + B$
190 LINESUM = LINESUM + B$
200 IF (B$ < 256) THEN LSET A$ = CHR$(B$)
210 PUT #1
220 NEXT J%
230 READ LINECHECK%
240 IF LINECHECK% <> LINESUM THEN PRINT "Error in Line";200 + 10 * I%
250 NEXT I%
260 CLOSE
270 IF CHECKSUM = 96431 THEN PRINT "Successful Completion!": END
280 PRINT "COM file is not valid!": #ND
290 DATA 233, 10, 3, 67, 111, 112, 121, 114, 771
300 DATA 105, 103, 104, 116, 32, 49, 57, 56, 622
310 DATA 54, 32, 88, 105, 102, 102, 48, 50, 595
320 DATA 97, 110, 105, 115, 32, 80, 117, 90, 762
330 DATA 100, 105, 115, 104, 105, 110, 103, 32, 762
340 DATA 67, 111, 46, 26, 83, 117, 110, 77, 637
350 DATA 111, 110, 84, 117, 101, 87, 101, 100, 811
360 DATA 04, 104, 114, 70, 114, 105, 83, 07, 771
370 DATA 114, 74, 07, 110, 70, 101, 00, 77, 743
380 DATA 97, 114, 05, 112, 114, 77, 97, 121, 797
390 DATA 74, 117, 110, 74, 117, 100, 65, 117, 762
400 DATA 103, 03, 101, 112, 70, 00, 116, 70, 771
410 DATA 111, 110, 60, 101, 99, 31, 20, 31, 507
420 DATA 30, 31, 30, 31, 31, 30, 31, 20, 244
430 DATA 31, 64, 0, 0, 46, 251, 120, 252, 772
440 DATA 0, 116, 0, 46, 255, 46, 235, 0, 703
450 DATA 46, 120, 62, 252, 0, 0, 117, 243, 848
460 DATA 156, 46, 255, 30, 235, 0, 46, 59, 827
470 DATA 6, 115, 1, 116, 1, 207, 46, 100, 600
480 DATA 6, 252, 0, 1, 46, 140, 22, 230, 706
490 DATA 0, 46, 137, 30, 241, 0, 140, 204, 006
500 DATA 250, 142, 212, 100, 235, 0, 251, 00, 1350
510 DATA 03, 01, 02, 05, 06, 07, 30, 6, 540
520 DATA 232, 31, 0, 7, 31, 05, 04, 93, 503
530 DATA 00, 00, 00, 00, 00, 142, 21, 162, 010
540 DATA 230, 0, 46, 130, 30, 241, 0, 251, 954
550 DATA 100, 0, 46, 190, 6, 252, 0, 0, 602
560 DATA 235, 174, 14, 14, 31, 0, 252, 232, 050
570 DATA 171, 1, 235, 0, 144, 136, 54, 245, 995
580 DATA 0, 137, 14, 246, 0, 232, 03, 0, 712
590 DATA 100, 0, 205, 22, 50, 6, 115, 1, 500
600 DATA 117, 4, 232, 144, 1, 105, 130, 54, 005
610 DATA 245, 0, 139, 14, 246, 0, 120, 252, 1024
620 DATA 75, 117, 10, 210, 200, 121, 162, 1170
630 DATA 11, 73, 235, 30, 144, 120, 252, 77, 055
640 DATA 117, 13, 254, 100, 120, 254, 11, 126, 1101
650 DATA 100, 102, 0, 65, 235, 7, 144, 120, 057
660 DATA 252, 75, 117, 9, 65, 120, 249, 16, 000
670 DATA 39, 120, 100, 235, 176, 120, 252, 00, 1224
680 DATA 117, 102, 73, 120, 249, 46, 6, 126, 020
690 DATA 175, 235, 162, 232, 140, 0, 142, 6, 1099
700 DATA 243, 0, 160, 245, 0, 152, 105, 3, 000
710 DATA 0, 246, 225, 100, 65, 1, 246, 910
720 DATA 139, 62, 254, 0, 3, 62, 240, 0, 760
730 DATA 131, 190, 22, 172, 232, 13, 1, 226, 996

```

(Figure 2 continues)

Figure 2: A BASIC program that will create POP-CAL.COM

the calendar function begins. Otherwise, the key is simply passed along to the caller and POP-CAL relaxes until the next call for a key.

Although it's not essential, POP-CAL uses a 2-byte trigger key to give the user the widest possible choice of trigger keys consistent with simplicity. To generate an even wider choice, the next logical step would be to begin requiring a triple-key combination to be pressed before triggering, such as pressing the Alt key in concert with, say, the Left Shift key and some

standard letter. This is fairly easy to implement, requiring only that the BIOS shift keys be tested, along with the value returned in AX from the Alt and third key. You may want to experiment with this just for fun.

PROTECTING THE STACKS In order to return control to the calling program successfully after calendar processing has been completed, POP-CAL must ensure that the caller's stack and all of the caller's registers (except AX) are exactly as they

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778 DATA	179	4	246	227	5	4	8	139	884
788 DATA	62	249	8	3	248	138	22	248	978
798 DATA	6	138	282	182	6	227	5	232	992
808 DATA	288	8	232	251	7	42	282	7	1111
818 DATA	138	38	245	8	58	255	138	151	1887
828 DATA	101	1	176	1	232	151	8	254	916
838 DATA	192	131	199	4	254	282	11	168	8
848 DATA	226	242	232	1	235	237	232	1419	8
858 DATA	166	8	226	251	232	5	8	117	997
868 DATA	246	14	7	195	3	62	249	8	776
878 DATA	131	199	4	7	177	7	254	286	195
888 DATA	139	94	246	8	198	6	182	6	746
898 DATA	28	247	198	3	8	137	5	198	796
908 DATA	6	182	1	29	187	6	8	139	478
918 DATA	198	45	47	6	256	216	5	2	522
928 DATA	6	116	8	153	247	24	4	133	8
938 DATA	216	129	254	164	6	124	35	139	1667
948 DATA	198	45	64	6	177	108	153	247	998
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978 DATA	72	43	216	153	177	4	247	241	1153
988 DATA	3	216	198	181	3	58	228	138	927
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1008 DATA	226	251	139	195	153	177	7	247	7
1018 DATA	241	136	22	248	8	195	89	83	1085
1028 DATA	212	18	5	48	48	128	252	48	751
1038 DATA	117	7	128	255	3	116	2	188	888
1048 DATA	32	116	216	138	196	232	28	8	972
1058 DATA	138	195	232	15	91	88	195	954	4
1068 DATA	176	32	232	7	8	232	4	8	683
1078 DATA	131	199	4	195	82	139	22	8	772
1088 DATA	1	136	224	136	168	1	117	251	1136
1098 DATA	258	236	6	116	251	138	196	1396	1396
1108 DATA	178	251	71	98	195	232	68	8	1869
1118 DATA	139	22	8	1	131	234	2	142	671
1128 DATA	6	113	1	38	138	62	182	8	459
1138 DATA	139	199	36	247	238	198	185	4	1157
1148 DATA	139	62	249	8	142	6	243	8	841
1158 DATA	179	11	185	38	8	38	139	5	587
1168 DATA	165	137	68	254	226	247	3	62	1162
1178 DATA	249	9	258	281	138	6	138	6	1396
1188 DATA	238	14	7	195	6	142	6	113	721
1198 DATA	3	38	161	74	8	289	224	163	878
1208 DATA	254	8	44	68	163	249	8	38	889
1218 DATA	161	9	5	6	163	8	163	8	889
1228 DATA	1	198	6	251	8	112	38	138	744
1238 DATA	38	73	8	128	251	7	184	8	673
1248 DATA	176	116	13	184	8	184	246	195	1114
1258 DATA	3	116	5	198	6	254	188	31	188
1268 DATA	163	243	8	7	195	232	188	255	1283
1278 DATA	191	185	4	138	38	251	8	176	983
1288 DATA	32	185	74	1	243	171	87	198	983
1298 DATA	44	179	7	191	185	164	71	188	668
1308 DATA	199	184	8	185	8	164	71	188	668
1318 DATA	226	252	71	71	254	283	117	243	1437
1328 DATA	188	42	285	33	254	286	136	54	1118
1338 DATA	245	8	137	14	246	8	51	192	885
1348 DATA	142	18	38	161	8	161	8	161	889
1358 DATA	8	38	161	98	8	163	237	8	689
1368 DATA	184	117	1	258	38	163	88	8	841
1378 DATA	38	148	14	98	8	251	98	285	828
1388 DATA	38	8	8	8	8	8	8	8	8

(Figure 2 ends)

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■ PROGRAMMING/UTILITIES

were when POP-CAL took control. To do this, it needs to save the registers in some easily accessible location. While normally this is done by "pushing" them onto the current stack, POP-CAL has no way of knowing whether or not there is room for them. If the stack overflows, it will probably trash code or important data, causing the calling program to go into a tailspin.

To avoid potential overflow problems, POP-CAL switches the stack to an area in its own program prefix area, which has ample room. To do so, the caller's stack segment address and pointer are first saved within POP-CAL's program prefix area. The stack segment is then changed to POP-CAL's own code segment, and the stack pointer is reset so that the next "push" will begin storing data immediately below the ROM16h variable in the PPF.

FLAGGING THE STACK Solving the overflow problem unfortunately also generates a brand new hazard. Suppose POP-CAL has seen an Alt-C, saved the caller's registers, and is now waiting for a cursor key to be pressed. Without some sort of flag telling it not to, the next Alt-C seen would cause POP-CAL to start saving the "caller's" registers all over again. In this case, however, the caller would be POP-CAL itself, and it would end up saving its own registers on top of those saved for returning to the original caller.

To protect POP-CAL's stack from itself, the BUSY flag is introduced. It is set as soon as the first Alt-C is seen and stays on until the calendar work is done and all of the caller's registers are restored. Any other approach would invite disaster.

WINDOWING Once POP-CAL has set its BUSY flag and saved the caller's registers, it next must clear away an area of the screen for displaying its calendars. Of course, since the user will presumably wish to continue with his work after this excursion into date checking and calendar generation, POP-CAL must save the user's original screen data as well. Then when returning from making calendars, POP-CAL can restore the screen as though nothing had happened.

While BIOS routines are available for reading data from the screen, as well as writing data on the screen, these are quite

■ The more ambitious reader might enjoy modifying POP-CAL so that calendars are available in graphics modes. Two methods come to mind.

slow. So, although they have the advantage of working under all video modes, POP-CAL ignores them in favor of faster direct buffer update techniques. To conserve code, however, only standard monochrome and color (and EGA) text modes are actually handled properly. Hence, while POP-CAL will run in graphics modes and will save and restore the screen, the display is useless in graphics.

The more ambitious reader might enjoy modifying POP-CAL so that calendars are available in graphics modes. Two obvious methods come to mind immediately: convert the direct video I/O to use the slower BIOS routines, or temporarily switch the video into a text mode while making and displaying calendars. This latter approach may at first blush seem the simplest, but don't be fooled. Remember that the BIOS routines for switching video modes also erase the screen, and one of the ground rules for POP-CAL is that the caller's screen must be restored.

POP-CAL has all the rudiments necessary to produce a more nicely formatted calendar, like the one found in *SideKick*, and it certainly has a wider range of time periods available. Adding today's date, vestigial prior and next month dates at the two ends of the month, grid lines for appearance, and the ability to slide the calendar across the screen took me another 700 bytes of code; you might enjoy trying to add these refinements on your own. □

Leo Forrest is president of Security Development Corp. in Washington state.

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AMOUNT: \$100.00

TO: Household Expenses

MEMO:

CHOICES:

(A) Appliances & Home Furnishings	(M) Medical & Dental
(B) Business-related Expenses	(N) Recreation & Vacation
(C) Clothing	(O) Supplies & Miscellaneous
(D) Debt/Financing Interest	(P) Transportation
(E) Education	(Q) Other (create new account)
(F) Food	
(G) Gifts	(R) To correct mistakes
(H) Housing	(S) To cancel transaction
(I) Insurance	

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■ JARED TAYLOR

SPREADSHEET CLINIC

Reader tips on handling dates and printouts of unknown length in 1-2-3, plus a set of tests to help you decide if a coprocessor is really worth it.



PLOTTER DATA

Here is an innovative use of a spreadsheet to solve a problem. We had to send a text file of instructions to a plotter. The instructions were similar, but not identical, and varied in a regular mathematical fashion. It would have been simple but time-consuming to make the calculations and enter the data by hand.

We solved the problem by using the /Replicate command in SuperCalc, though most any spreadsheet could probably be used in the same way. We entered the basic pattern of the instruction, with a formula for the necessary mathematical adjustments, and replicated it as many times as we needed it. We saved the worksheet as a text file and then sent the information directly to the plotter.

Martin LaBar
Central, South Carolina

This is a good example of the unexpected benefits of spreadsheets. As we have seen in other submissions to this column, people have turned spreadsheets into word processors, BASIC editors, and TV script writers.

These off-beat benefits are due to two things. The first is that spreadsheets are a very sophisticated, specialized kind of text editor that can build a relationship into data and then copy the data repeatedly according to this relationship. Newer, more sophisticated spreadsheets have text string functions that can reproduce alphabetical as well as mathematical relationships. Thus, whenever you need repetitive data, a spreadsheet is often a much better pro-

gram to use than a word processor. When the peculiar screen-editing powers of a spreadsheet happen to fit your need, they can be a tremendous time saver.

The second essential feature is that most spreadsheets can produce ASCII text. Once your data is arranged and calculated to suit your purposes, you may no longer need the underlying formulas, macros, and range names. It's in this plain ASCII format that spreadsheet data finds surprising homes. The next time you're frustrated by a program editor, word processor, database, or graphics program, you might just ask yourself if what you're doing wouldn't be easier with a spreadsheet.

SPEED TEST WITH AN 8087

I have done some tests to see how much the Intel 8087 math coprocessor speeds up calculations in 1-2-3, Release 2.0. Since I had heard that the coprocessor affects different kinds of math operations in different ways, I decided to give it several tests.

Figure 1 shows the different formulas I

used for testing and the differences in speed. The time results are for calculating each formula 2000 times. The greatest difference was in the @LOG function: 62 seconds without the 8087 and a blazing 3.99 seconds with it. Curiously, the amortization table took a little longer to do after I installed the 8087; as is well known, addition and subtraction are not much affected by the math chip.

Clearly, whether the coprocessor is a good investment depends on the size of your spreadsheets and the kinds of math they perform.

David Smith
Austin, Texas

POP-UP NOTEPAD

The macro in Figure 2 creates a pop-up notepad window in Symphony. I use it for any important information about my spreadsheets and can change its size and location by changing the parameters of the macro. I keep the macro in a library and can load it into any worksheet that needs it.

FORMULA	W/O COPROC. TIME [Seconds]	WITH COPROC. TIME [Seconds]	TIMES FASTER
@COS(0.5)	42.99	5.04	8.5
@SQRT(33)	35.03	3.97	8.8
@LOG(5)	62.00	3.99	15.5
@LN(5)	59.01	5.00	11.8
@EXP(5)	58.99	4.99	10.2
@ATAN(5)	53.98	5.00	10.8
50^50	33.98	6.83	5.6
35^45	8.97	4.98	1.8
600/37	10.03	4.96	2.0
@PMT(90000,0.08,30)	62.00	9.03	6.9
@MORT TABLE (360 PMTS)	5.98	6.00	1.0

Figure 1: Time tests on 1-2-3, Release 2.0, with and without the 8087 math coprocessor chip.

■ SPREADSHEET CLINIC

```
\w {windowsoff}{services}\c\notepad""(up 6)
{left 37}
{right}"a8178,d8192"
{right}"{right 2}"{escape}{windowson}{quit}
```

Figure 2: A Symphony macro that builds a pop-up notepad.

Whenever I leave myself (or someone else) a note to be read before more work is done on the worksheet, I include an autoexec macro that switches to the notepad window as soon as the file is retrieved. To get back to the main window, just hit F6.

Lee Wootenn
Opelika, Alabama

DATE ENTRY

I design spreadsheets that will be used by people unfamiliar with 1-2-3. The biggest problem is date entry. The @date format makes no intuitive sense, and many people have trouble entering a date when the year part must come first.

Release 2.0 provides the answer. With {getlabel} and {datevalue} you can let people enter dates as MM/DD/YY, which is a much better understood format. To make the macro in Figure 3 work, establish a named range of one cell in an out-of-the-way part of the spreadsheet. In the figure, this cell is called DATER and is located nearby for clarity.

The cells where the dates are to go should be date-formatted. Run the macro and it will prompt for a date in the MM/DD/YY style.

Carl Slutter
Olney, Maryland

This macro permits date entry in a form that most people understand. Also, with a loop and a {down} or {right}, it could prompt for a series of dates in a column or row. Finally, it could be easily modified to date-format the target cells.

QUICK COPY

Here's a tip that will save you time when you copy data in 1-2-3. Suppose you are

working in row 1000 of a spreadsheet and find you need to copy something from around row 500. If you don't know the exact cell address or haven't given it a range name, you've got some work to do. Most people would page-up to row 500, start the copy operation, and mark the FROM range. Then they'd page-back to row 1000 and hit Enter. But then the cursor jumps back up to row 500, because that is where it was when you started copying. You probably still want to be in row 1000. If you don't remember exactly where you were, you probably can't use the Goto key and you end up paging back to row 1000.

It's a whole lot easier to start with the cursor in the cell you want to copy TO. Hit /C, then Backspace to unanchor the FROM range. Now page-up to row 500 and mark the FROM range. Hit Enter twice and your copy operation is done. What's more, the cursor ends up in row 1000, which is probably where you wanted to be anyway.

John Predmore
Fairport, New York

A little-known but very handy technique.

POOR MAN'S WORKSHEET PROTECTION

Here's a rough-and-ready way to keep 1-2-3, Release 1A, data confidential even if you haven't got a file encryption program. It's hardly bulletproof, but it will keep most people out of your data. Just include an autoexec macro (\B) that will erase the entire worksheet:

/wey

If someone retrieves the worksheet, it will erase itself immediately. You, however,

can get your data back by using a trick that not everyone is likely to think of: use the /File Combine command to read the sensitive worksheet into another worksheet. A problem with this solution is that /File Combine will leave out all your settings and ranges. If they are important, make another copy of your sensitive worksheet but erase all its data. Save that worksheet without the self-destructing autoexec macro. Now when you need the sensitive data, you can first retrieve the ranges-and-settings worksheet, then combine the confidential worksheet into it.

Norberto O. Di Natale
Buenos Aires, Argentina

This is an amusing little security method for data that isn't terribly sensitive. An obvious way to defeat it, of course, is to hit Ctrl-Break very quickly as soon as the worksheet appears. I find that about half the time I can nail the autoexec macro before it erases the worksheet.

Instead of /wey as the autoexec, I would use /qy. Not only does this execute just a touch faster, it also kicks the unauthorized user right out of 1-2-3.

DATE AND TIME STAMP

With Release 2.0 of 1-2-3, you now have an easy way to put the system date and

	C	D	E
3		W	{goto}c6"
4			/wcel18"
5			/RFD"
6	16-Jun-86		{DOWN}
7	08:53 AM		{RIGHT}"
8			/RFD{RIGHT}"
9			{DOWN}
10			{DOWN}
11			/EQ

Figure 4: A macro that date- and time-stamps your worksheet.

time in your worksheet. The macro in Figure 4 uses the @now function twice to do the job.

Use the macro either by itself or as part of your autoexec, print, or save routines. I find that it's particularly useful for anyone who has to update and print a worksheet several times in one day. At the end of the day, just check the date to see which print-out is the most recent. Save it and throw the rest away.

Jerry Allison
Dayton, Ohio

```
\d {getlabel "Enter date using MM/DD/YY . . ",date}{datevalue(date)}"/cv""
12-Dec-86 DATER 6/17/86
05-Apr-86
38-Dec-85
17-Jun-86
```

Figure 3: A macro that allows easy date entry in 1-2-3, Release 2.0.

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■ SPREADSHEET CLINIC

```

\p      (GOTO)header-cell*
        /PPR
        { FIND_DOWN}
        AQQ

FIND_DOWN  [IF @CELLPOINTER("prefix"<"") {DOWN} {BRANCH find_down}
            {RETURN}]

```

Figure 5: A macro for 1-2-3, Release 2.0, that will print a column of unknown length even if the column includes blank cells.

PRINTING A WORKSHEET OF UNKNOWN SIZE

If you build 1-2-3 applications for other people, you sometimes have to write routines that print or graph ranges that vary in length from one work session to the next. In Release 1A of 1-2-3 you could use {end} {down} to establish a vertical range, but any blank cells would throw it off. For print ranges, {home}. {end} {home} sometimes works, but deleted rows or blank, formatted cells could distort the range.

With Release 2.0, @cellpointer gives you a way to measure a range of unknown size. The macro in Figure 5 will print any column that begins with a cell named header-cell and ends with a cell containing the \ prefix (used as in \- or \= to fill a cell). The \ prefix is used here as a marker; you could use anything you like. The routine will not stop at blank cells, so you'll get the whole column in your range.

Steve Gehlen
Stayton, Oregon

I like the way the FIND_DOWN subroutine is called in the middle of the range-finding exercise. The cursor works its way down the spreadsheet and gets to the \ prefix more quickly than you might expect.

If you wanted to use this technique for a print range of varying width as well as length, you could use two marker-finding routines, one after the other. Once the vertical search had found the last row of the spreadsheet, a horizontal search could find the last column.

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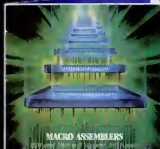
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TURBO POWER USER



Turbo tips on handling signed integers, adding a clock to your programs, setting border colors, and an undocumented feature for redisplaying data.

MIS-SIGNED INTEGERS

In the Power User column of Volume 5 Number 9, you correctly modified Mr. Sato's code because it would not handle Turbo Pascal's interpretation of signed integers. Unfortunately, you let the same error pass in the section immediately following, which was entitled "Using DEBUG with Turbo." The line that causes the same old problem is

```
S := S + HexDigits [(N Div (1 Shl (4 * I)))];
```

If N is greater than \$7FFF (i.e., is a negative integer in Turbo), your program will have an index out of range in the array HexDigits. One method of converting to hex digits that does not cause these problems and allows the line immediately following the one in question to be eliminated from the program is

```
S := S + HexDigits [(N Shr (4 * I)) and $000F];
```

This method uses the sign-insensitive shr rather than sign-sensitive div.

Craig Siegman
Bellevue, Washington

I modified Mr. Siegman's code even further, as shown in Figure 1. It now assigns a value to each character of the HexString individually, and it directly sets the length byte to indicate a four-character string. This is much faster than building up a string by adding characters to it. The reason is that all the Turbo string routines, including the simple '+' between two strings, have to be prepared to operate on string function results. Turbo copies the strings to a stack before working on them,

```
Program AddrPcn; {Prints Address of Variables and Proc}
{$R+} {turn range checking on}
Const HexDigits : Array[0..15] of Char = '0123456789ABCDEF';
Type HexString = String[4];

Function HexPcn (N : Integer) : HexString;
Var
  I : Integer;
  temp : HexString;
Begin
  temp[0] := #4;
  For I := 0 To 3 do
    temp[4-I] := HexDigits [(N Shr (4 * I)) and $000F];
  HexPcn := temp;
End;

Begin
  writeln(HexPcn(Ord(HexPcn)));
  writeln(HexPcn($765));
end.
```

Figure 1: A corrected function that prints Turbo integers as unsigned hexadecimal numbers.

and this copying takes time. The HexPcn conversion routine in Figure 1 is about twice as fast as the original.

LIFE IN THE OLD KEYS YET

Michael Johns's menu selection function in Power User (Volume 5 Number 11) is a neat way to present user choices, but it suffers from one flaw: some supposedly "dead" keys turn out to be active. For example, F2 and F4 will move the star in the same way as do the angle bracket (>,<) keys. [Alt-Z and Alt-C do it too—Ed.] This occurs because those (and other special) keys place two values in the keyboard buffer, and the second value is the same as the "ord" value assigned to another, regu-

lar key. The first value for these special, double-value keys (in Turbo) is always 27, which is the same as the regular "ord" value of the Esc key.

Fixing the problem is easy. After the "read(kbd,input)", just test the value of "input" to see if it is 27. If it is, and if another "key" is waiting, read and discard "input." Assuming that the throwaway variable has been declared as "discard," the additional code you need is shown in Figure 2. The "KeyPressed" is necessary—without that, the routine would ignore a valid key pressed immediately after the Esc key.

Jose VacaPena
Upper Marlboro, Maryland

```
If (Ord(input) = 27 and KeyPressed) then read (Kbd,discard);
```

Figure 2: A patch to a previously published Turbo menu selector function.

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PRODUCTIVITY

■ TURBO POWER USER

TICK TOCK

A real-time ticking clock on the screen gives a program a professional look. Mr. Galen Spooner, of Stevens Point, Wisconsin, submitted a routine to create such a clock, but unfortunately I couldn't get his implementation to work on my (standard

IBM) machine. So I cleaned up my own version of the same program, which is shown in Figure 3.

The IBM PC issues Interrupt \$1C on every "clock tick"—approximately 18.2 times per second. In a "clean" PC with no resident programs, this interrupt does

```

PROGRAM Test_clock;
VAR
  What : STRING[80];

(* ----- JUSTCLOCK.INC BEGINS ----- *)
VAR
  Timer_Seg, Timer_Off : Integer;
  Gblcount : Bytes;
CONST
  ScreenSeg : Integer = 8;
  SaveCSeg : Integer = 0;
TYPE
  Rgpack = RECORD
    CASE Integer OF
      1 : (Ax, Bx, Cx, Dx, Bp, Si, Di, Os, Es, Fflags : Integer);
      2 : (Al, Ah, Bl, Bh, Cl, Ch, Ol, Dh : Byte);
    END;
  AnyStr = STRING[255];
VAR
  reg : Rgpack;

PROCEDURE Screen_Write(S : AnyStr; X, Y : Bytes; Attr : Integer);
VAR
  I : Integer;
BEGIN
  Attr := Attr SHL 8; { Set up Attribute in High Byte }
  FOR I := 1 TO Length(S) DO { "poke" the string into video RAM }
    Mem[ScreenSeg*(Y-1)*160+(X+Y-2)*2] := Attr OR Ord(S[I]);
  END;

PROCEDURE clock;
CONST
  ampm : ARRAY[0..1] OF STRING[2] = ('am', 'pm');
VAR
  Hiclock : Integer ABSOLUTE $40 : $6E;
  Loclock : Integer ABSOLUTE $40 : $6C;

  tics, HiWord, LoWord : Real;
  hours, mins, secs : STRING[2];
  time : STRING[10];
  am_or_pm : Integer;

BEGIN
  INLINE(
    $56/$53/$51/$52/ {PUSH AX, BX, CX, DX} {save all registers }
    $56/$57/$1E/$04/ {PUSH SI, DI, DS, ES}
    $2E/$0C/$0E/$0E/$0E/ {MOV CS:SaveCSeg,CS} {save OUR Code Segment }
    $F0/ {STI} {allow interrupts }
    Gblcount := Succ(Gblcount);
    IF Gblcount > 17 THEN BEGIN
      HiWord := Hiclock;
      LoWord := Loclock;
      IF HiWord < 0.8 THEN HiWord := 65536.0 + HiWord;
      IF LoWord < 0.8 THEN LoWord := 65536.0 + LoWord;
      tics := HiWord*65536.0 + LoWord;
      tics := tics/18.286481934;
      Str(TFunc(tics/3600.0) MOD 12, hours);
      am_or_pm := TFunc(tics/3600.0);
      IF hours = '0' THEN hours := '12';
      IF hours[8] = '1' THEN hours := '0'+hours;
      Str(TFunc(tics/60.0) MOD 60, mins);
      IF mins[8] = '1' THEN mins := '0'+mins;
      Str(TFunc(tics-Int(tics/60)*60, secs);
      IF secs[8] = '1' THEN secs := '0'+secs;
      time := hours+'.'+mins+'.'+secs+amp[am_or_pm OIV 12];
      Screen_Write(time, 71, 1, 15);
      Gblcount := 0;
    END;
  INLINE(
    $87/$1F/$5F/$5E/ {POP ES, DS, DI, SI} {restore all registers }
    $5A/$59/$5B/$50/ {POP CX, CX, BX, AX}
    $5B/$55/ {MOV SP,BP} {UN-do what TURBO did to }
    $D/ {POP BP} {begin this procedure }
    $CF/ {IRET} {... and return }
  )
END;
  
```

(continues)

Figure 3: A procedure that puts a ticking clock on the screen from within a Turbo program.

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■ TURBO POWER USER

■ A real-time clock on-screen gives a program a professional look.

nothing at all. However, if you change the interrupt vector for \$1C to point to a routine of your own devising, that routine will be called 18.2 times per second.

Because the routine is being called 18 times a second, it had better not try to do much else, or there will be trouble. Also, you may not call any other interrupt in the process of servicing this interrupt. If you modify JUSTCLOCK to your own use, don't try to write the time with an ordinary Turbo write statement—you'll crash your system. In fact, all you can safely do during this interrupt is examine and manipulate memory locations. So we get the time by peering at the double-word time-value in low memory rather than by querying the BIOS.

```

PROCEDURE Save_Old_Timer;
BEGIN
  WITH reg DO BEGIN
    AH := $35;
    AL := $1C;
    MemDos[reg] := ES;
    Timer_Off := DX;
  END;
END;

PROCEDURE Install_Our_Timer;
BEGIN
  WITH reg DO BEGIN
    AH := $25;
    AL := $1C;
    DS := CSeg;
    DX := Offs(Clock);
    MemDos[reg] := ES;
  END;
END;

PROCEDURE Restore_Old_Timer;
BEGIN
  WITH reg DO BEGIN
    AH := $25;
    AL := $1C;
    DS := Timer_Seg;
    DX := Timer_Off;
    MemDos[reg] := ES;
  END;
END;

PROCEDURE Timer_Error(ErrNo, ErrAddr: Integer);
BEGIN
  WriteLn('RESTORING the normal timer interrupt');
  Restore_Old_Timer;
END;

PROCEDURE Init_Clock;
BEGIN
  IF Mem[$0040:$0049] = 7 THEN ScreenSeg := $b000
  ELSE ScreenSeg := $b000;
  SaveCSeg := CSeg;
  Gbcount := 10;
  Save_Old_Timer;
  Install_Our_Timer;
  ErrorPtr := Offs(Timer_Error);
END;

(* ----- JUSTCLOCK.INC ENDS ----- *)

BEGIN
  CtrScr;
  Init_Clock;
  WriteLn('The timer is now installed. Type some lines to see how it works.');
```

(Figure 3 ends)

To begin using the clock, we first save the current clock-tick interrupt vector, using DOS Function Call \$35. Next, we install the new Interrupt Service Routine using Function Call \$25. That's all we need do—whatever else the program does after this, the clock in the upper-right-hand corner will continue to tick away.

But what happens when the program ends? We absolutely must reinstall the previous timer interrupt vector. Otherwise, 18.2 times a second, DOS will transfer control to an area of RAM that may not even contain executable code—and that means it's time for the Big Red Switch. Even if the program crashes, that vector has to be returned to its previous state. So, we use one of Turbo's lesser-known features to gain control: a User-Written Error Handler. By setting the Turbo internal variable ErrorPtr to the offset of a procedure, you cause control to go to that procedure when the program crashes. You could supply descriptive error messages based on the ErrNo and ErrAddr parameters, but here we'll just restore the interrupt vector. To see the error handler in action, simply end the program with Ctrl-Break.

The **INLINE** code that begins and ends the clock procedure itself is almost exactly the same as that shown on page 214 of the Turbo 3.0 manual. The only addition is the restoration of the Turbo program's Code Segment. This is necessary if the Interrupt Service Routine is to be able to call other routines within the program.

Try the demo program. It simply echos back lines of text that you type. The clock ticks away independently. To use this technique in your own program, then, separate JUSTCLOCK.INC into a file and **\$Include** it in your program. Call **Init_Clock** at the start of your program and **Remove_Clock** at the end.

UNKNOWN FIND

I've discovered a very useful but previously undocumented keystroke in the Turbo Pascal editor. When you select "Q" F or "Q" A ("find" and "find and replace"), the last data entered can be redisplayed by pressing "F" (Ctrl-F). I found it very helpful when you need to correct the last "find" entry. The trick also works in other places where the Turbo editor asks for a re-

■ TURBO POWER USER

sponse, e.g., "Read Block from file."

Avital Jacob
Haifa, Israel

SideKick retains the previous data, and I had wondered why the Turbo editor didn't. Now I see that it does.

■ COLORFUL TEXT

Some time ago, User-to-User (Volume 5 Number 13) presented a program demonstrating a BASIC-like COLOR procedure.

```
PROGRAM Text_Border;
VAR
  Border_Color : BYTE;
  response : CHAR;
BEGIN
  WriteLn('Press any key to cycle the border color, or Q to Quit.');
```

Border_Color := 0;

REPEAT

 GraphBackground(Border_Color);

 read(Kbd, response);

 Border_Color := Succ(Border_Color) mod 16;

UNTIL UpCase(response) = 'Q';

END.

Figure 4: "GraphBackground" can be used in text mode to set the border color.

■ A very useful but previously undocumented keystroke in the Turbo editor is Ctrl-F.

The author used a BIOS call to set the border color. I've discovered a trick for Turbo 3.0 that is easier still. The statement "GraphBackground(X);", used in text mode, will set the border to the color X (from 0 to 15) as shown in Figure 4.

Loren De La Osa
Milton, Washington

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Neil J. Rubenking is a professional Pascal programmer.

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PRODUCTIVITY

■ USER-TO-USER

```
100 'FASTSCRN2.BAS -- by Larry Zimmerman -- Adapted by PC Magazine
110 DEFINT A-S:DEF FNEXT$(S$)=LEFT$(S$,INSTR(S$+","))-1)+".COM"
120 INPUT "Source name file: ";INFILE:OPEN INFILE FOR INPUT AS #2
130 OUTFILES=FNEXT$(INFILE):PRINT "Program name: ";OUTFILES;" ";
140 INPUT " ",TEMP$:IF LEN(TEMP$)>0 THEN OUTFILES=FNEXT$(TEMP$)
150 OPEN OUTFILES AS #1 LEN=1:FIELD #1, AS A$:CHECKSUM=0
160 FOR L=1 TO 128:READ B$:B$=VAL("AB"+B$):(CHECKSUM=CHECKSUM+BYTE
170 LSET AB=CHR$(INTE):PUT #1:NEXT IF CHECKSUM=128 THEN 190
180 CLOSE:KILL OUTFILES:PRINT "Error: ";OUTFILES;" not created.";END
190 CLS:PRINT "Creating ";OUTFILES:LINE$=0:WHILE LINE$ < 24
200 IF NOT EOF(2) THEN LINE INPUT $2,LS ELSE LS=""
210 L=LEFT$(LS,80):IF LEN(L$) < 80 THEN L$=L$+SPACES(80-LEN(L$))
220 LINE$=LINE$+L:FOR I=1 TO 80:LSET AS=MID$(L$,I,1):PUT #1:NEXT
230 WEND:CLOSE:PRINT OUTFILES;" created.";END
240 ' *****
250 ' Notes: (1) If your screen NEVER displays snow, change the #1
260 ' in line 320 to #0. (2) The #7 in line 320 is the attribute;
270 ' substitute your own (the left digit of which is a hex value
280 ' from 0-7 (background); the right digit a hex value from 0-15
290 ' (foreground) as 4E is bright yellow on red. (3) If you change
300 ' these, adjust the CHECKSUM value in line 170 accordingly.
310 ' *****
320 DATA ED,00,00,00,00,53,01,41,07,1A,33,C0,0E,C0,26,A1
330 DATA G3,04,05,00,00,A3,02,01,00,00,0F,C0,10,00,FC,50
340 DATA 75,5A,53,3C,03,76,0E,3C,07,75,51,00,00,00,C0,0E
350 DATA 06,01,00,ED,0A,00,00,01,06,75,77,03,05,00,00,0E
360 DATA C0,00,00,06,0A,3E,00,01,09,00,00,0A,47,0C,10
370 DATA 99,0F,07,0F,00,00,0E,00,0E,01,0E,3E,05,01,00,7A,0E
380 DATA 0B,16,02,01,ED,00,00,72,70,00,00,00,13,70,AA
390 DATA 47,02,06,00,00,02,0A,00,17,5B,0C,10,CD,20,00,00
```

Figure 2: BASIC FASTSCRN2 program, similar to FASTSCRN, to create .COM files that flash text screens almost instantly.

COPY MYFILE \DOS\UTILITY\MYFILE

you're in trouble.

Back up early and often. And when you do, make sure you don't accidentally back up to the same subdirectory.

BATCH STRING COMPARE

DOS makes it easy to control branching by passing parameters into batch files from the command line. You can then use IF statements to compare such parameters and branch accordingly. But DOS is case sensitive, which means that a string N

■ Make sure you don't accidentally back up to the same subdirectory.

characters long requires 2*N IF statements to compare all of the permutations of uppercase and lowercase letters. A string containing the three characters ABC

```
100 ' Program for creating COMPARE.COM
110 PRINT "Checking DATA statements; please wait..."
120 FOR B=1 TO 9:FOR C=1 TO 17:READ AS:IF C=17 THEN 140
130 S=S+VAL(A$)
140 NEXT:END
150 IF S=13419 THEN RESTORE:GOTO 100
160 PRINT "Wrong number of DATA statements, or error in a BIG"
170 PRINT "NUMBER at the end of a line -- CHECK AND READ":END
180 FOR B=1 TO 9:FOR C=1 TO 16:READ AS:TTL=TTL+VAL("AB"+AS)
190 NEXT
200 READ S:IF S=TTL THEN 220
210 PRINT "DATA ERROR IN LINE";B*10+20;"-- CHECK AND READ":END
220 TTL=0:NEXT:RESTORE
230 OPEN "COMPARE.COM" AS #1 LEN=1:FIELD #1, AS DS
240 FOR B=1 TO 9:FOR C=1 TO 16:READ AS:LEST DS=CHR$(VAL("AB"+AS))
250 PUT #1:NEXT:READ DUMMYS:NEXT:CLOSE
260 PRINT "COMPARE.COM CREATED"
270 DATA BE,01,00,FC,AC,3C,20,74,7B,3C,00,74,4C,4E,56,5F,1726
280 DATA 20,03,AC,3C,20,74,17,3C,20,74,0A,3C,00,74,3A,00,1373
290 DATA 44,00,41,EB,ED,AC,3C,20,74,7B,3C,3D,75,20,AC,3C,1740
300 DATA 30,75,25,AC,3C,20,74,7B,4E,56,20,DE,AC,3C,00,74,1634
310 DATA 0A,3C,20,74,06,EB,1E,00,43,EB,F1,3B,00,75,11,5E,1519
320 DATA 00,0F,03,06,74,0C,ED,00,00,00,00,0A,74,02,21,2005
330 DATA 00,00,04,4C,CD,21,3C,61,72,09,3C,7A,77,05,24,5F,1107
340 DATA 00,44,FF,C3,53,70,00,74,61,78,20,65,72,72,52,72,00,57
350 DATA 00,0A,24,00,00,00,00,00,00,00,00,00,00,00,00,00,55
```

Figure 3: COMPARE.BAS to create COMPARE.COM case-insensitive ERRORLEVEL tester.

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CIRCLE 472 ON READER SERVICE CARD

■ USER-TO-USER

```

echo off
if %1==1 goto oops
compars %1==%2
if errorlevel 255 goto match
echo the strings are not equal
goto end
:match
echo the strings are equal
goto end
:oops
echo The format required is:
echo COMPTST STRING1 STRING2
:end

```

Figure 5: *COMPTST.BAT* batch file. Create *COMPARE.COM* and the batch file above, then type *COMPTST* hello *HELLO*.

"PATH/FILE access error" message emblazoned across my screen.

I used *PC Magazine's* *ATTR.COM* attribute setting program and found the file was read-only. Removing this read-only attribute let me save it and made me realize that this combination of ".P" and read-only protection could keep non-power users from unscrambling files.

Robert T. Collina
Lake Hopatcong, New Jersey

That's what the file attribute byte is for, and Charlie Petzold's terrific ATTR program lets you check and change any attri-

■ The combination of the "P" option and read-only protection could keep non-power users from unscrambling files.

bute anywhere. One note—if you didn't have *ATTR* handy, once you unprotected the *BASIC* program you could have easily saved it to another disk.

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PC TUTOR



How to react to CHKDSK error messages without tranquilizers, moving files from one directory to another, and controlling multiple line feeds.

MESSAGES FROM CHKDSK

I recently tried to save a file from my spreadsheet and couldn't do so because there was not enough space on the floppy disk. I had thought there were about 170K free. When I got back to DOS, I found that DIR reported that I had 0 bytes free. I ran CHKDSK with the /F parameter to see what was going on and discovered that my files had become cross-linked and that I had some lost clusters. CHKDSK then created a series of .CHK files that filled up the rest of the disk.

How do files become cross-linked and what can be done about it? What is the stuff stored by CHKDSK in a .CHK file?

Richard Teich

Los Angeles, California

Almost nothing on the PC is as terrifying as seeing a list of unfamiliar messages from CHKDSK. Sometimes the messages indicate very serious problems with the data on the disk and sometimes not.

Among other things, CHKDSK checks for consistency between the disk's directory entries and its file allocation table (FAT). The FAT is a map of the disk that shows how the disk's clusters are chained to link the data in each file.

When you get a "lost clusters" message from CHKDSK, there's usually not too much to worry about. What it means is that an area on the disk has been allocated for a file but that the file was never properly closed. The lost clusters are orphaned: the FAT says they've been allocated, but they don't belong to an file. This sometimes happens if the program creating the

file terminates abnormally or runs out of disk space and doesn't clean up afterward.

If you run CHKDSK with the /F parameter, it converts lost clusters to files in the root directory and gives them the extension .CHK. If your normal files are missing something, that data could be in one of the .CHK files. You can take a look at the .CHK files with the TYPE command, but unless they're in ASCII format and came from a word processing document, you probably won't be able to do much with them. If you're missing entire files from your directory, these .CHK files may correspond to the missing files. This might be the result of having a damaged directory. In such a case, the FAT still allocates chained clusters as if they belonged to a file, but the directory doesn't indicate where the chains begin.

Messages from CHKDSK indicating "cross-linked files" are cause for more concern. Cross-linking means that the

FAT's cluster chain for two or more files intersects at some point, so that some clusters seem to belong to multiple files. In other words, your FAT or directory has probably been badly mangled. Although cross-linking is relatively rare, it can be caused by gremlins (i.e., a power surge or line drop during a disk write operation). In theory, gremlins strike randomly, but in practice they do their thing only to your most important files.

Watch out for this easy-to-make mistake: You can easily create a cross-linked FAT and a mangled directory by replacing a disk before typing an answer to an "Abort, Retry, Ignore" message. (I've done this a couple times, and each time I've become furious with myself because I should know better.) Say you're in a program and try to save something to a floppy disk that has a write-protect tab. DOS tries to write to the disk and then displays a "Write Protect Error" message followed by "Abort, Retry, Ignore." Instead of taking the write-protect tab off the disk (maybe you've just realized that the disk is the wrong one), you choose to put in another disk and press R for Retry. You can now kiss that data goodbye.

The problem is that DOS has already read FAT and directory information from the disk and modified that information before trying to write it back to the disk. It displays the "Abort, Retry, Ignore" message only after it fails the write operation. When you hit R to indicate Retry, DOS doesn't know that the disk has been replaced and thus writes the modified FAT and directory (or part of it) that it's read

■ You can create a cross-linked FAT and a mangled directory by replacing a disk before typing an answer to an "Abort, Retry, Ignore" message.

■ PC TUTOR

into memory from the original disk onto the new disk.

Can such disks be recovered? Sometimes you can salvage pieces of files using the Norton Utilities and piece them back together, but it's hard work and you need to know what you're looking for. The best protection is making frequent backups.

FILES ON THE MOVE

I've been trying to create a batch file to "move" a file from one directory to another. The problem seemed simple enough at first, but my difficulty is error detection. I don't want to delete the file from the original directory until I'm sure the copy went without error. How can I do this? Is it reasonable to do this in a batch file?

Mark Wager-Smith
Walnut Creek, California

Batch files are not adequate when error checking is crucial. While some DOS programs return error codes that can be used with the batch file ERRORLEVEL keyword, ERRORLEVEL does not work for the internal DOS commands such as COPY.

Moreover, there are definitely better ways to do this particular job. Moving a file from one directory to another on the same hard disk does not require copying the file and then deleting the original. While the DOS RENAME command does not allow you to do so, there are DOS function calls that let you "rename" a file by changing its subdirectory path. This process changes only the directory entry without moving the contents of the file.

John Dickinson's REDirect program (Programming/Utilities, Volume 4 Number 4) makes use of these DOS function calls, and it conveniently supports global filenames. If you have a modem, you can download the RED program from PC Magazine's Interactive Reader Service by calling (212) 696-0360.

The Power User column in Volume 5 Number 3 shows a number of alternative C, Turbo Pascal, BASIC, and assembly language programs to "move" files from one directory to another and to rename subdirectories (a similar job). [See also John Dickinson's RENDIR.COM in our Programming/Utilities column, Volume 5 Number 7—Ed.] One of these Power User

approaches used a combination of a batch file and the BASIC NAME command, which (unlike the DOS RENAME) allows files to be "moved." The batch file (which you can call MOVEDIR.BAT) is small enough to be repeated here. It creates a one-line BASIC instruction containing the NAME command and then loads BASIC to execute that command:

```
ECHO NAME "%1" AS "%2" >TEMP.TMP
BASIC <TEMP.TMP
DEL TEMP.TMP
```

To move a file from one subdirectory to another, just enter

```
MOVEDIR C:\DIR1\FILENAME C:\DIR2\FILENAME
```

Neither Dickinson's RED nor this .BAT file approach will let you move files from one drive to another, however.

TOO MANY LINE FEEDS

We have a Radio Shack TRS-80 Model III that is being retired in favor of an IBM PC AT, but we'd like to use the TRS-80 Daisywheel II printer with the AT. It is quite compatible except for extra line feeds. It seems that the AT is putting out carriage returns plus line feeds at the end of text lines and that the printer automatically adds a line feed every time it gets a carriage return. Result: double line feeds. There are no switches, internal or external, to disable the printer's automatic line feed. Is there a way to turn off the line feeds the AT sends through the parallel port?

Thomas R. Harrington
Washington, D.C.

With PC software and printers, it's pretty standard these days that a carriage return (ASCII 0Dh) returns the printhead to the left column and a line feed (ASCII 0Ah) drops it down one line. However, some older printers (generally daisy wheels) cannot do carriage returns without line feeds. Sometimes these printers ignore a line feed that immediately follows a carriage return, but often they do not.

Let me also defend the AT from the charge of sending out extraneous line feeds. The only place the AT itself explicitly writes a carriage return and line feed sequence to the printer is in the BIOS Print Screen routine. Otherwise, the AT BIOS is just doing what it's told, and most programs tell it to print carriage returns and

■ After you run NOLFS .COM, line feeds will be blocked from reaching the printer.

line feeds to go to a new line. When you echo something from the screen to the printer (with a Ctrl-PrintSc), DOS and the BIOS will send carriage returns and line feeds to the printer, but that's only because these same characters are also being sent to the screen.

If you'll be doing most of your printing from applications programs, you may be able to configure the programs to skip down to a new line with just a carriage return. Many programs that do printing have some way to turn off line feeds. For instance, in 1-2-3, Release 1A, it's a simple matter of executing a /Worksheet Global Default Printer Auto-LF Yes. (Actually, considering that this option is buried six levels deep in the menu, maybe it's not simple, but it's definitely possible.)

If all else fails, try the brute force method. Using Figure 1 and DEBUG, you can create a small resident program called NOLFS, which stands for "No Line Feeds." Once loaded, this program simply blocks all line feeds (ASCII 0Ah) from going out to the printer.

To create the executable program, type the lines shown in Figure 1 into an ASCII file called NOLFS.SCR. Then execute

```
DEBUG <NOLFS.SCR
```

This will create the executable NOLFS.COM. (As an alternative you could load DEBUG and type in the lines shown in Figure 1 directly.) After you run NOLFS.COM, line feeds will be blocked from reaching the printer. If you have your printer set up for LPT2 rather than LPT1, change the line reading

```
CMP DX, 0
```

to

```
CMP DX, 1
```

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
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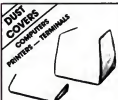
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